



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MAY 5, 1892.

TEXT-BOOKS OF PSYCHOLOGY.

The Human Mind: a Text-book of Psychology. By James Sully, M.A., LL.D. Two Vols. (London: Longmans, 1892.)

Hand-book of Psychology: Feeling and Will. By James Mark Baldwin, M.A., Ph.D. (London: Macmillan, 1891.)

Text-book of Psychology. By William James. (London: Macmillan, 1892.)

IN his treatise on the "Human Mind," Mr. Sully has not attempted to supplant, but rather to supplement, his own admirable "Outlines of Psychology." The method in the two works is the same, and the arrangement of the subject-matter, though it differs slightly in some details, is, on the whole, essentially and in principle similar. A chapter has been added on the physical basis of mental life, dealing briefly with the nervous system and with neuro-psychical correlations. But the author wisely refers his readers to text-books of physiology or to manuals of physiological psychology for a full treatment of these matters. He also gives an adequate account of the recent experimental researches on the nature and conditions of some of the simpler responsive activities, but is not blind to the difficulties and uncertainties of this so-called experimental psychology.

It is well known that Mr. Sully lays great stress on the genetic method in psychology.

"It is evident," he says, "that we require a knowledge of these psychical elements [reached by analysis] and of the laws of their combination, in order to account for the complex products of the mature human consciousness. Now, the perfect account of a thing means the history of that thing from its first crude to its completed form. When the psychologist has succeeded, by analysis, aided by objective observation and hypothesis, in obtaining the requisite data, he proceeds to reconstruct the course of psychical development."

From the standpoint of biology and evolution, this genetic aspect of psychology is of especial importance,

and we cannot be too grateful to Mr. Sully for his able, clear-headed, and, on the whole, cautious presentation of this view of the matter. But it is one which, as Mr. Sully himself well knows, is of peculiar difficulty. Few of us remember anything of the genesis of our modes of psychological procedure in the early days of our life; and when we do remember scraps here and there, we are only too apt to interpret them in terms of our adult procedure, with which we are so much more familiar. It is, moreover, well nigh impossible for the psychologist to realize the nature of the psychical processes of the child, so that infant psychology is a field wherein we may suppose much and can prove little. Mr. Sully again and again appeals to the supposititious child.

"The child, for example," he says, "begins to note that some varieties of living things, *e.g.* flies or birds, die. He then compares these results, and, extracting the common relation, finds his way to the more comprehensive generalization, 'All animals die.' Later on he compares this result with what he has observed of flowering and other plants, and so reaches the yet higher and more abstract generalization, 'All living things die.'"

Of course there may be a child here and there who proceeds, or, in the absence of all instruction in the matter, might proceed, thus. But children and uneducated persons very rarely reach a general and universal concept, properly so called. The child notes that its pets and other animals die or are killed: this begets a stronger and stronger expectation that other animals will likewise die or be killed some day; and the expectation may rise to practical certainty without anything like a universal concept taking even vague and indefinite shape in the mind. We therefore question the statement that "by induction the child reaches a large number of general or universal judgments," though it is unquestionable that he may have a large number of expectations which the logician may cast in universal form. He may even state them in universal form himself, and say, "Animals die," "Apples have pips," the language he uses being here, as in so many cases, in advance of his conceptions.

In the discussion of the development of the moral sentiment, the distinctively moral feeling is perhaps

hardly differentiated with sufficient care from the merely prudential. The prudential does not pass up into the moral on the same line of development; but the prudential and the moral are separate and sometimes widely divergent lines of development. It is sometimes said that the prudential is self-centred while the moral is social. But is not what is socially right different from what is socially prudent? Or, in other words, is not morality something other than social prudence? Remorse for wrong has a different psychological quality from regret for error, no matter what the social implications of the error may be. Mr. Sully does not seem to have sufficiently brought out this distinction in his account of the genesis of the moral sense.

But though there may be room for some difference of opinion as to the exact course of genetic development by which our more complex and more highly evolved psychological states have been reached, there can be no question that Mr. Sully's painstaking and thoughtful discussion of their possible or probable mode of evolution is and will long remain of real and sterling value. No living writer has paid more attention to this important aspect of psychology.

There is one more point on which we may comment before we pass on to Prof. Baldwin's work. It is the doctrine of residual fusion.

"The simplest form of assimilation," we read, "is to be found in that process by which a present sensation (or sensation complex) is re-apprehended or 'recognized' as something familiar. . . . What takes place here is the calling up by a present sensation of the trace or residuum of a past sensation (or sensations), which trace merges in or coalesces with the new sensation, being discernible only through the aspect of familiarity which it imparts to the sensation. . . . We have to conceive of the nervous process somewhat after this manner. A given central element or cluster of elements is re-excited to a functional activity similar to that of a previous excitation. The residuum of this previous activity or surviving 'physiological disposition' somehow combines with and modifies the new activity; which blending of nervous processes has for its psychological correlative the peculiar mode of consciousness known as recognition, sense of familiarity, or identification. Here, however, our physiological psychology seems to be more than usually conjectural."

And again—

"In recognition the percept and the image are fused, the presence of the latter being indicated merely in the peculiar appearance of familiarity which the percept assumes."

This so-called "fusion" of the percept and the image seems to us an awkward figure by which to describe the facts. The sequence of states of consciousness in the case of (a) practical or perceptual, and (b) reflective or conceptual recognition, seems to be briefly as follows. Suppose I recognize a man, A, as one whom I have met before, say at a dinner party. Then I have first a percept

$A_{q.n.s.y}$, where A is the individual in question in the focus of consciousness, and $q.n.s.y$ the "fringe" generated by his present surroundings, more or less out of focus. This percept is immediately followed by the image

$A_{s.r.t.b}$, where A appears amid different surroundings.

This constitutes practical or perceptual recognition. In

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reflective or conceptual recognition there follows an act of introspection (or retrospection), whereby the common central element in the two states of consciousness is explicitly identified. There is no fusion in either case, except in so far as sequent states of consciousness have a central or focal element which is identifiable. If we simply recognize A as someone we have met somewhere, we do not remember where, there is associated with the focal image, A , an indefinite fringe of pastness serving to differentiate it from the percept with its fringe of present surroundings; and if, on the other hand, we recognize A as a quite familiar person whom we have seen again and again amid all sorts of surroundings, there is a fringe which we can only describe as involving both pastness and frequency. In the case of the animal or the child, recognition presumably does not pass beyond the practical stage—that is to say, a percept A with this fringe is followed by an image A with that fringe. Reflective recognition, involving retrospection and a comparison of the two images (A with this fringe and A with that fringe) and the identification of the element common to both, is a product of conceptual processes of later genesis.

In conclusion, it is sufficient to say that by his treatise on the human mind Mr. Sully fully sustains his reputation as a psychologist.

In his volume on "Feeling and Will," Prof. Baldwin has completed the survey of the mind begun in his "Senses and Intellect."

The first three chapters contain an adequate physiological introduction. There is, however, one statement which seems to us awkward if not misleading. After briefly noting the views that have been suggested as to the relation of consciousness to the so-called nervous conditions, Prof. Baldwin says:—

"It has become apparent that nervous activity, considered by itself alone, does not bring us into the range of psychological science. However we may decide the inquiry as to whether such activity is ever entirely free from consciousness, it is yet true that it may be quite outside of what is called the individual's consciousness. . . . In other words, the greater part of our ordinary nervous reactions are not above the threshold of our conscious lives. So we reach a distinction between sentience as a nervous property and sentience as a conscious phenomenon, between *sentience* and *sensibility*. Sensibility is synonymous with the usual consciousness of the individual's experience, and sentience is the nervous function which may or may not be accompanied by consciousness or inner aspect in general. . . . The transition from simple sentience to the full consciousness is through a stage of subconscious modification."

With no desire to be hypercritical, this does not seem to us altogether satisfactory. Sentience is spoken of as "the nervous function which may or may not be accompanied by consciousness." The words we have italicised seem to imply that sentience belongs to the physical, not the psychical order of existence. If so, the "transition from simple sentience to full consciousness" is a transition from the physical to the psychical order, and consciousness becomes a mode of energy. We do not think that this is the author's meaning; but in that case it would be well so to define sentience as to clearly show that though it may not rise to the level of consciousness, it is none the less of the conscious or psychical order.

When we leave the physiological and enter the psychical field, appeal is constantly made to the "principle of apperception" or "selective synthesis." But does not the author go somewhat beyond what is justified by our very imperfect knowledge of the facts of cerebral physiology when he asserts that "after we enter consciousness, we find a principle of apperception to which there is no analogy in physiological integration"? Elsewhere he says: "Now, as a fact, the great principle of mental organization, selective synthesis, finds no apparent counterpart in physics." In direct opposition to this view, we venture to contend that nothing is more remarkable than the parallelism (if it be no more) of selective synthesis in the physical and the psychical spheres. In the physical world this is best seen in the formation of chemical compounds and their segregation in crystalline form. In the psychical world it is seen in the so-called principle of apperception. This is, however, only the expression in the conceptual sphere of a principle which, stripped of all metaphysical implications, must be extended to the whole range of psychical life, as a general law of psychogenesis. In the organic world (at any rate the animal world) the two principles (if two they be) meet. And if, notwithstanding the splendid work done in bionomics, through the application of "natural selection" to the elucidation of the problem, we have not yet reached a scientific expression of selective synthesis in organic life and growth, this is no proof that there is no such selective synthesis.

In accordance with the general principles he adopts, Prof. Baldwin divides feeling into the two great classes of (1) sensuous feeling, and (2) ideal feeling. Sensuous feeling relates to the bodily functions. "Sensuous pleasure," says the author, "may be defined as the conscious effect of that which makes for the continuance of the bodily life or its advancement; and sensuous pain, the conscious effect of that which makes for the decline of the bodily life or its limitation." Ideal feelings, on the other hand, are the modifications of sensibility which accompany the exercise of the apperceptive function. Ideal pleasure may be defined as "the conscious effect of that which makes for the continuance of the apperceptive life or its advancement; and ideal pain, the conscious effect of that which makes for the decline of the apperceptive life or its limitation." But though sensuous feeling can have no reference to the conceptual or apperceptive life, ideal feeling has reference (however much we affect to despise or ignore the mere body) to physical as well as intellectual well-being. Hence Prof. Baldwin concludes "that ideal tone (pleasure or pain) refers to personal well-being as a whole."

We must pass over without comment an important and interesting discussion of "reality and belief," which is worthy of careful consideration, and may proceed to note the somewhat unusual sense in which the author uses the word "ideals."

"Ideals," he says, "are not mental constructions at all: if once constructed they would no longer be ideals: which only means that what we call ideals are emotional in their nature, expressing the drift or felt outcome of the constructive process, not any actual attainment of it. If my ideal man, for example, were an intellectual construction, I would be able to describe him. . . . Ideals, there-

fore, are the forms which we feel our conceptions would take if we were able to realize in them a satisfying degree of unity, harmony, significance, and universality."

This seems to us somewhat strained. It is a description of theoretically ideal ideals which have been emptied of all practical value. There are assuredly practical ideals which, though unattainable, can be definitely realized as intellectual constructions permeated with emotional tone. And it is these practical ideals which are influential on conduct.

The distinction between subjective and objective ends in ethics is carefully drawn. Subjective ends are the felt and more or less definitely realized motives of the voluntary process. They alone have psychological value as the immediate determinants of conduct. Objective ends are a matter of cognition.

"Even though it were granted that all voluntary action arose and survived by exclusive reference to pleasure or to self-realization, yet it would be a patent fallacy to say that the only voluntary end is either of them—that consciousness has all along been versed in our biology or our speculative ethics, and has aimed to fulfil the one or the other. Consciousness has no inkling of the *δωσις* of Aristotle, or the *connatus* of Spinoza, or the *Trieb* of Wundt and Schneider; of the 'strife [*sic*] for existence' of Spencer, the theoretic 'reverence for law' of Kant, the 'self-realization' of Green, or the dialectical 'becoming' of Hegel. Let us discover these things if we may, but do not let us say that a man is not moral unless he has a realizing sense of them."

We have left ourselves no space to deal with Prof. Baldwin's discussion of the phenomena of the will. We do not by any means agree with all that he says thereon, but it is worthy of careful consideration.

Prof. James's "Text-book of Psychology" is a rearranged abridgment of his larger "Principles," with the addition of some description of the senses and sense-organs. We have so recently (*NATURE*, vol. xliii. p. 506) expressed our opinion of the value of the larger work, that we can, without injustice to Prof. James, afford to be brief in our notice of this abridgment, merely selecting the chapter on "Instinct" on which to offer a few comments.

Every organism comes into the world with an innate capacity to perform, more or less definitely, certain activities under the appropriate environing circumstances. Of these activities, a certain number which are (1) complex in character, and (2) performed (a) in a definite way, (b) without foresight of the end to be attained, (c) with no previous education in the performance, and (d) uniformly by all normal individuals of the species concerned, are now by pretty common consent described as instinctive. Clearly such instinctive actions are the outcome of the innate capacity of the animal which performs them; but they are a peculiar and special manifestation of this innate capacity: they have definite and clearly assignable characteristics. Now no one can question that man comes into the world with a relatively enormous store of innate capacity, and that he has innate tendencies to perform half a hundred particular activities. And yet he has but few instincts. He leads a life of hesitation and choice, an intelligent life. To say with Prof. James that this is "not because he has no instincts—rather because

he has so many that they block each other's path" is practically to abandon the position which has been painfully and slowly gained by those who have thought and written on instinct. Instinct is a definite and special manifestation of innate tendency: here the innate tendency is not manifested in this definite and special way, but is thwarted. To call both manifestation and non-manifestation alike instinct is, in our view, a retrograde step, which we regret that a psychologist of Prof. James's insight and influence should have taken.

We cannot, however, leave the book with a note of dissent; for we find far more in this text-book to agree with than to dissent from. Whether we agree or dissent, we always find Prof. James full of stimulating thought; and we advise all who are interested in psychology to read at least the chapters on "Habit," "The Stream of Consciousness," and "The Self," if they read no more.

C. LL. M.

DYNAMICS OF ROTATION.

Dynamics of Rotation: an Elementary Introduction to Rigid Dynamics. By A. M. Worthington. Pp. 155. (London: Longmans, Green, and Co., 1892.)

Spinning Tops. By John Perry. Pp. 136. (London: Society for Promoting Christian Knowledge, 1890.)

THE persistence of spinning tops and of running bicycles in rearing themselves erect are common examples of a wide class of dynamical phenomena which are influenced or governed by the presence of rapidly rotating parts, and which have a prominent place in all departments of physical science, from the relations of the systems of the stars down to molecular actions.

In formal treatises on abstract dynamics we are accustomed to find the properties of freely rotating systems relegated to an advanced part of the development of the subject, and expounded with all the powerful help which mathematical analysis can afford. If we are to have a complete theory of the circumstances which determine the stability and transformations of rotational motions, this analytical aid is none too extensive. But there is another mode of approaching a physical subject, which consists in learning from observation and properly varied experiment what are the phenomena that are persistent and stable, and then applying known dynamical principles to the elucidation of the properties of the motions thus known in fact to exist—a problem which need not in those simpler cases which are fundamental require any great amount of analytical knowledge.

As an additional reason for the customary abstract development of dynamics, there may perhaps be counted the historical fact that the questions that were of paramount importance when dynamical principles concerning extended systems of bodies were being evolved, related to the orbital and axial motions of the heavenly bodies, and their reconciliation with the law of universal gravitation. The absence of frictional resistances, and the long duration and delicacy of astronomical observations, had led to a minute knowledge of the motions of the solar system, which taxed all the resources of Clairaut, D'Alembert, Laplace, and Lagrange, to verify and explain.

Many of the dynamical principles which are now
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treated as elementary and fundamental were thus come upon in special analytical investigations relating to physical astronomy. It was, for example, in this way that the principle of the conservation of angular momentum for the solar system was discovered by Laplace, and then generalized to a system with any kind of internal connections which is not subject to forces from outside it. How far a general principle of this kind, when divested of its analytical dress, enables us to see into the general causes of things is well known. A striking illustration is the *aperçu* of Prof. James Thomson, that when once the trade winds have been explained as a consequence of the earth's rotation, they involve of necessity the existence also of anti-trades or south-west winds in the temperate zone; for if the trades blew by themselves their friction against the earth would always be acting round in the same direction, and therefore would tend to stop the earth's rotation, not by wholly destroying its motion, but by transferring its angular momentum undiminished to the atmosphere, where it would continually accumulate. This simple remark thus shows that the trades blowing to the equator must be compensated by anti-trades blowing from it; and therefore also explains the existence of a region of high barometer between them. It will also occur to memory how much J. Purser, W. Thomson, and specially G. H. Darwin, have established in the tidal evolution of the earth-moon system, by studying the possibilities of development that are allowed subject to the conservation of its angular momentum and the degradation of its energy.

It has been reserved for our own half-century to bring out the wealth of general dynamical ideas that is contained in the magnificent analytical presentation by Lagrange of the results of the application of the laws of motion to systems of bodies, the number of variables or co-ordinates being of necessity (for analytical purposes) restricted to the number of degrees of freedom, and everything turning out to be expressible in terms of one fundamental function—the energy of the system. It will be apparent, on looking through Prof. Cayley's Reports on Dynamics to the British Association, how much the progress of this department of abstract dynamics was indebted to the necessities of astronomy. That science presented a problem which was in one sense quite definite and precise, on account of the smallness of the planetary masses, but which nevertheless required a minute explanation of the perturbations to which the planetary bodies are subjected owing to their mutual actions. The methods which proved comprehensive and efficient for this purpose also showed themselves, when they were examined from a more general standpoint, to reveal principles of a far-reaching character, that applied to dynamical systems however complicated. The final stage of analytical development was reached when the keen perception of Sir W. R. Hamilton saw that the whole subject could be removed from special considerations of space and time, and attached to the purely analytical treatment of a single varying action function; and the commentary of Jacobi showed precisely how to pass from this general differential analysis to the solutions of special dynamical questions.

At the present time there seems to be no danger of the interruption of progress by too close an adherence to the

calculus. The fact is, that nearly all the problems of the numerical calculation of perturbations which were urgent at the beginning of the century, in order to bind the solar system to the scheme of universal gravitation, have now been satisfactorily disposed of. There is no longer the same need for the greatest intellectual power to set itself to put right some periodic or secular inequality, which requires all the battery of analysis that is available, and often more. New ground has been broken since then, and there is the great array of the physical sciences, all struggling to become purely dynamical, but all hampered in this by the fact that the dynamical machinery, the phenomena of matter and motion, on which they depend, are to a great extent concealed from direct observation or exploration. Under such circumstances the method of progress is to carefully cherish, and reduce into a scheme such as will appeal directly to the understanding, all the general principles which have become evolved in the course of dynamical investigations relating to problems of which the data are thoroughly known; and to use them as a key for the dynamical interpretation of more recondite phenomena by the aid of analogies and the numerical verification of their results. The mode of progress has thus veered from the analytical to the synthetical, from the powerful inverse analysis of Laplace and Lagrange to methods more akin to those which were worked by Newton.

It may be stated as a general rule that the relations most directly intelligible and most flexible in this kind of application are properties of constancy, or of maximum and minimum, such as belong in fact to the more obvious features of the continuous growth of pure quantity. The conservation of energy, of linear momentum, of angular momentum, the minimum energy criterion of equilibrium, of steady motion, the maximum and minimum energy criteria which determine the motion following the application of impulses specified either by their actual amounts or by the velocities they produce at their points of application—these may all be cited in illustration. The crown of the edifice will be Maupertuis's principle of Least Action, whose range of exact application, initiated for dynamics by Lagrange and Hamilton, is now being extended into all departments of physics, thus working out an answer to the question—To what extent can the succession of phenomena in inanimate Nature from instant to instant be treated as governed by a principle analogous to that of minimum expenditure of effort in the sentient world?

The phrase from instant to instant is essential, for a path may—as, for example, a great circle on a sphere—be the shortest between two points within a given range of each other, but may cease to have that property when the starting point and the final point are taken too far apart on it. In a similar way, in statics, a certain region of stability is determined around each position of equilibrium, such that, if the system is not disturbed beyond that region, it will not leave the neighbourhood; while, in dynamics of a particle, such a region is more vaguely determined around each orbit by the nature of the enveloping curves or surfaces of the neighbouring orbits.

From the point of view of the direct appreciation of dynamical ideas, the small books at the head of this

article form a very welcome addition to the ordinary text-books. The work of Prof. Perry, popular lecture though it be—and one feels constrained, from the confident style, to believe that his audience of operatives understood every word of it—leads on the reader by vivid illustration into contact with the boldest flights of dynamical speculation. After the ordinary effects of spin have been copiously illustrated, we are taken into a world in which matter has two kinds of inertia; and, by aid of a chain of balanced gyrostats, we learn that a cord cannot ever transmit motion straight on without also twiddling about. It is fortunate for those of us who have to follow or teach mechanical pursuits that this new species of matter is not often heard of, and is only called up in relation to such unnoticeable, and practically insignificant, phenomena as rotation of the plane of vibration of light waves. The relations of ordinary mass to gravitation, and such like are sometimes intricate enough things to discuss; the introduction of a second kind of mass, and that of a vector character, might lead to despair.

The great pioneer in this field of work, of eliciting the concealed dynamical mechanism of tangible phenomena, is, of course, Lord Kelvin, by whom nearly all our knowledge on the subject has been originated, at any rate in its present exact form. Prof. Perry's book is all the more welcome and suggestive, in that it claims to be chiefly a connected account of what he has learned at first hand from the teaching of Lord Kelvin; an account which has possibly not been published before by anyone, at least in a consecutive form.

Prof. Worthington, after an elementary quantitative introduction to dynamical principles, has gone over the part of dynamics of rotation which relates to a single spinning solid, in the manner of a text-book with numerical illustrations; and there is no doubt that a mastery of his explanations would be a very valuable part of the outfit of a student of physics.

J. L.

THE MAMMALIA OF BRITISH INDIA.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Mammalia. Part II. By W. T. Blanford, F.R.S. (London: Taylor and Francis, 1891.)

IN our issue of September 27, 1888, we had the pleasure of bringing before the notice of our readers the first part of Mr. Blanford's valuable monograph on the Mammals of British India. The second part, completing this important work, has lately been published. The delay, as is explained in the preface, has been caused by the necessity Mr. Blanford has been under of spending much time in editing the five volumes of the same series that have appeared since the first part of the present work was issued. His labours in this respect have been increased by two unfortunate and unforeseen circumstances—the lamented death of Mr. Francis Day, and the expiration of the leave of Mr. E. W. Oates, in both cases before the termination of the portions of the work, on fishes and birds respectively, upon which they were engaged, and the completion of which has thus fallen upon Mr. Blanford himself.

In the preface of the present part, the origin of the series to which it belongs is thus related:—

"The need for new and revised descriptive works had, for some years before 1881, been felt and discussed amongst naturalists in India, but the attention of the Government was, I believe, first called to the matter by a memorial dated September 15 of that year, prepared by Mr. P. L. Sclater, the well-known Secretary of the Zoological Society, signed by Mr. Charles Darwin, Sir J. Hooker, Prof. Huxley, Sir J. Lubbock, Prof. W. H. Flower, and by Mr. Sclater himself, and presented to the Secretary of State for India. This memorial recommended the preparation of a series of hand-books of Indian zoology, and my appointment as editor. It is scarcely necessary to add that to the recommendation of men so highly respected and well known in the world of science, the publication of the present 'Fauna of British India' is greatly due, and that Mr. Sclater is entitled to the thanks of all interested in the zoology of India for the important part he took in the transaction."

We are also glad to learn from the same source that the series of works on the fauna of British India will not be confined to the Vertebrata, the preparation of three volumes on Moths by Mr. G. F. Hampson having been commenced. We trust that these will be followed by others dealing with those groups of which sufficient material is available, and for which authors may be forthcoming capable of treating them in a manner worthy to be placed by the side of those already issued.

The second part of the Mammalia contains the orders Chiroptera, Rodentia, Ungulata, Cetacea, Sirenia, and Edentata. It is fully equal to its predecessor in careful selection of the material which is most likely to be useful and attractive to those readers for whom the work is chiefly intended. The descriptions, geographical distribution, and accounts of the habits of the various species can be thoroughly relied upon. Nomenclature is always a thorny subject in zoology, and though Mr. Blanford is usually most careful and judicious in his work in this department, we cannot agree with him in substituting the specific name of *maximus* for the time-honoured and universally used *Elephas indicus*. The inconvenience of changing the name by which such a familiar animal is designated in thousands of books and museums, is so great that it can only be justified by some more imperious necessity than appears to exist in the present case. That *maximus* was applied by Linnæus to both the then known species, and that it is incorrect and misleading (the other existing, and many of the extinct, species being as large as, or larger than, the Indian elephant) are sufficient reasons, in our judgment, for leaving the name in the oblivion in which it has slept for nearly a century. Moreover, if *indicus* be rejected, the claims of Blumenbach's *asiaticus* cannot be overlooked.

The illustrations of the present part are far superior to those of the former one, and show a marked advance in the art of process-printing directly from the artists' drawings, without the intervention of the wood-cutter. Many of those by Mr. P. Smit, though printed from blocks in the text, have all the softness and delicacy of the finest specimens of lithography, and add greatly to the attractiveness of this valuable work.

W. H. F.

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OUR BOOK SHELF.

Tanganyika: Eleven Years in Central Africa. By Edward Coode Hore, Master Mariner. (London: Edward Stanford, 1892.)

MR. HORE was for eleven years a member of the Central African Mission established at Lake Tanganyika by the London Missionary Society, his special task being to undertake all the work that could be most effectually accomplished by one who had the knowledge and experience of a master mariner. In the present book he gives an account of his labours. The narrative contains many elements of interest, and will be read with pleasure by all who like to think of devoted courage in the service of great moral ideas. Mr. Hore became very familiar with Lake Tanganyika, which he surveyed in the first instance on board a native boat. Afterwards the British supporters of the mission enabled him to build two vessels in which he had opportunities of doing his work in a style worthy of its magnitude and importance. Of the physical characteristics of the lake and the surrounding regions he gives an unpretending but sound and sometimes picturesque account. He has also much to say about the natives, whose confidence and good-will he seems to have had a rare power of winning. He has a very favourable opinion of their capacities, and knows of no good reason why they should ever be treated by Europeans otherwise than with kindness and patience.

Beginner's Guide to Photography. By a Fellow of the Chemical Society. (London: Perkin, Son, and Rayment, 1892.)

THIS very cheap and useful little guide has now reached its fourth edition. The reader is led through all the phases of manipulation that at first sight seem so bewildering, but which with clear explanations are soon rendered more simple and eventually mastered. All questions relating to "How to buy a Camera, and how to use it," may be said to be here fully answered, and by following the instructions an amateur may be saved from much disappointment and expense. The explanations throughout the book are both clear and explicit, and the omission of such technicalities as might confuse rather than enlighten a reader will be found distinctly advantageous.

Quain's Elements of Anatomy. Edited by E. A. Schäfer, F.R.S., and G. D. Thane. In Three Vols. Vol. II., Part 2. By Prof. Thane. Tenth Edition. (London: Longmans, Green, and Co., 1892.)

IT is necessary here only to record the fact that the publishers have issued the second part of the second volume of this magnificent edition of Quain's standard work. The editor is Prof. Thane, and the subjects dealt with are arthrology, myology, and angiography. There are no fewer than 255 illustrations, many of which are coloured.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

[The Zebra's Stripes.]

ALMOST every writer who treats of the colours of animals refers to Galton's observations that in the bright starlight of an African night zebras are practically invisible even at a short distance; but there can be no doubt that their peculiar striped appearance is also of great protective value in broad daylight. On a recent zebra hunt near Cradock, in which I took part, several members of our party commented on the difficulties of seeing

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zebras even at moderate distances, although there was nothing to hide them, the black and white stripes blending so completely that the animals assume a dull brown appearance quite in harmony with the general colour of the locality in which they are found, and in which, for instance, Rooi Rehbok (*Pelea capreolata*) is also well protected on account of its peculiar brownish coat. A member of our party, who on another occasion gave proof that he is possessed of excellent eyesight, and who has frequently hunted in similar localities, saw a zebra which was wounded in one of the front legs at a distance of about 400 yards, and strange to say he mistook it for a big baboon. In a letter which I received from him a few days ago, he said, "It galloped like a baboon from me, and I could only see that the colour was greyish-brown. At about 500 yards from me it ran on to a little krantz, and mounting the highest rock, drew its body together just as a baboon does when its four feet are all together on the summit of a little rock." His remark as to the greyish-brown colour of the animal is the more valuable, as I believe this gentleman, Mr. Wrench, A.R.M. of Cradock, is quite unprejudiced. In my own letter to him, which drew forth these remarks, I had only asked him for the distance at which he saw the zebra, and I did not ask him how it was that he mistook a black and white zebra for a brown baboon on a perfectly clear South African day. My own observations also confirm that the stripes of the zebra are of protective value. Riding along a slope I suddenly saw four zebras within 100 yards above me. They were galloping down the hill, but stopped when they caught sight of me. As soon as they stopped I saw their stripes pretty distinctly. After I had fired and wounded one of them, they started again galloping down the hill round me in a semicircle at a distance of about 70 yards. All this time they presented a dull brown appearance, no stripes being visible, although I had my attention fixed on this point. They disappeared beyond a ridge, went down a little valley, and I heard afterwards that they ascended the next slope, which was not more than 1500 yards away from where I stood with a native servant. Yet even this lynx-eyed native could not see them going up this slope. They had vanished from us.

Perhaps it may interest some of your readers that zebras are still fairly plentiful on the rugged hills west of Cradock. A troop of forty-one individuals was seen, on the very ground over which we hunted, a short time before we arrived. Our party saw eleven in two days, but I believe three were seen on two if not on three different occasions. This would reduce their number to eight, if not to five. They are protected by Government, and also by the farmers themselves, but I am afraid that in spite of that their days are numbered. They are said to be very destructive to wire fences, and as the inclosing of farms with wire fences is steadily on the increase in this colony, many a farmer will have, though perhaps reluctantly and in defiance of the law, to take up his gun and clear them off his property. There will then probably be an outcry by people who know the difficulties of South African farming only from books written by travellers who hurry through South Africa in a first-class railway carriage; but those who really know South Africa well will say it is a great, great pity, but it cannot be helped, unless Government provides speedily an abode for these and other animals threatened with extinction. The first step in the right direction would perhaps be the establishment of a Government Zoological Garden, but I hope others who are more competent than I am will stir the people of Cape Colony up before it is too late, so that something more than mere game-laws may be done to preserve them.

Albany Museum, Grahamstown.

S. SCHÖNLAND.

The Protective Device of an Annelid.

IN September last I forwarded to NATURE the description of an effectual protective device adopted by a small tubicolous Annelid which had been sent to me from Jersey; the device consisting in the coiling-up of the end of the tube. I have recently been able to submit specimens to Prof. W. C. McIntosh, of St. Andrews, who has kindly identified the builder as *Sabella saxicava*, a form which he tells me is common in the Channel Islands, and occurs also on our southern coast. So far as I can learn, this peculiar and interesting habit of an Annelid had not previously been observed.

ARNOLD T. WATSON.

Sheffield, May 1892.

NO. 1175, VOL. 46]

The General Circulation of the Atmosphere.

IN that excellent lecture by Dr. Pernter, delivered before the Scientific Club at Vienna, published by you in NATURE (vol. xlv. p. 593), the theory of the trade winds being occasioned by the rising of the rarefied air at the equator causing an upward current, while cold air from north and south flows in to supply its place, coupled with the earth's rotation to the east, is attributed to Dr. Dove. "Dove was the first person . . ." But that theory will be found distinctly enunciated by Sir John Herschel in his "Treatise on Astronomy" (1833), where he attributes it to Captain Basil Hall, "where this is distinctly, and, as far as I am aware, for the first time reasoned out." Herschel was not aware that it had been distinctly reasoned out by George Hadley, F.R.S., in the thirty-ninth volume of the Philosophical Transactions, a century before Basil Hall.

J. CARRICK MOORE.

THE SURFACE-FILM OF WATER, AND ITS RELATION TO THE LIFE OF PLANTS AND ANIMALS.¹

IT is necessary to the exposition of my subject that I should begin by reminding you of some well-known properties of the surface of water. These are familiar to every student of physics, and are set forth in many elementary books. They are well explained and illustrated, for instance, in Prof. Boys's deservedly popular book on "Soap-bubbles." But there may be some persons here who have not quite recently given their thoughts to this subject, and it will only cost us a few minutes to repeat a few simple experiments, which will establish some fundamental facts relating to the surface-film of water.

The following experiments were then shown :—

(1) Mensbrugghe's float. Proves that the surface-film of water offers resistance to the passage of a solid body from beneath.

(2) Aluminium wire made to float on water. Proves that the surface-film of water offers resistance to the passage of a solid body from above. The resistance is proportional to the length of the line of contact of the solid with the water.

(3) Copper gauze made to float on water. Here, a number of intersecting wires are employed instead of a single wire, and the consequent increase in the length of the line of contact greatly increases the weight which can be supported.

(4) Frame with vertical threads, carrying a light plate of brass. The threads hang vertically at first, but when the whole is dipped into soapy water, the adhering film exerts a pull upon the sides of the frame, draws the threads into regular curves, and raises the brass plate. When the film is broken, the threads resume their previous vertical position, and the plate falls.

(5) Aluminium wire supported by vertical copper wires. Each end of the aluminium wire forms a loop, which fits loosely to one of the copper wires. When the apparatus is dipped into soapy water, the contraction of the film draws the aluminium wire upwards. After pulling it down with a thread, the wire can be again drawn up. This is another illustration of the tendency of the film to contract. We use soapy water, because the film lasts for a considerable time, but the surface-film of pure water, though less viscous than that of soapy water, is even more contractile. We have already seen that the surface-film clings with considerable tenacity to any solid body introduced into it, and that its hold increases with the length of the line of contact. It is for this reason that fine meshes offer so great a resistance to the passage of the surface-film. Air can pass through the meshes with perfect ease; water also, if not at the surface, can pass through readily enough, but the surface-film in contact with air will only pass through with

¹ Lecture given at the Royal Institution, March 4, 1892, by L. C. Miall, Professor of Biology at the Yorkshire College, Leeds. Some passages were omitted in delivery, for want of time.

difficulty, and if there is water behind it, the water may thus be restrained from passing through the meshes.

(6) Muslin bag hung in front of the lantern. Water poured into the bag (a large spoonful) does not flow out; but when the muslin beneath the water is rubbed with a rod, it becomes wetted, the surface-film passes to the outside of the bag, and the water trickles through.

There are many plants which take advantage of this property of the surface-film of water, viz. that it will not penetrate small spaces, in order to keep themselves dry. You must have observed how the hairy grasses repel water. The surface-film is unable to pass into the fine space between the hairs, and accordingly the water above the surface-film is kept from contact with the leaf. This simple artifice is often employed by plants which float at the surface of water. Here it is important that they should keep dry, not only for the purpose of respiration, but for another reason too. They commonly have great power of righting themselves when accidentally submerged, and this self-righting property depends upon the fact that the under surface of each leaf is always wet, while the upper surface is incapable of being wetted.

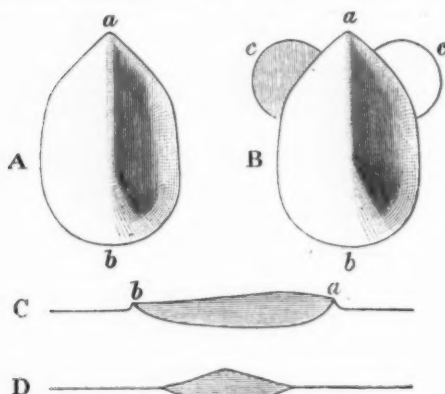


FIG. 1.—Duckweed (*Lemna minor*), magnified. A, single frond; a, scar of attachment to parent. A ridge extends from a to b across the upper surface of the frond, gently subsiding towards b. B, frond, budding-out two new fronds. C, longitudinal section from a to b (A), showing ascending capillary curves at a and b. D, transverse section, at right angles to the last. The margins of the frond in this plane are level with the surface of the water. N.B. The form of the fronds is somewhat variable. Minor inequalities occur along the margin, but the principal ascending curves, which are also centres of attraction, are at a, b, and c.

The microscopic hairs which thickly cover the upper surface are sufficient to exclude the water. A leaf of *Pistia* is now submerged, and shown as an opaque object in the lantern. You see by the gleaming of its surface that it is overspread by a continuous flat bubble of air, which looks like quicksilver beneath the water. I will next invert a leaf of *Pistia* by means of a rotating lever. It is now brought up beneath the surface of the water in an inverted position, and you see that, notwithstanding its buoyancy, it is unable to free itself and rise to the surface, because of the air-bubble, which adheres both to the leaf and to the disk at the end of the lever, and ties both together. Complete separation of the leaf from the disk would involve the division of the air-bubble into two smaller bubbles, one adhering to the leaf and the other to the disk. In this operation the surface-film would necessarily be extended directly in opposition to its natural tendency to contract. Several other water-plants exhibit the same properties as *Pistia*. I will mention two of the water-ferns—*Salvinia* and *Azolla*. *Salvinia* is found floating on still water in the warmer parts of Europe, as well as in other quarters of the globe. The leaves are attached on opposite sides of a horizontal stem. Long

hairy roots (or what look like roots, and really answer the same purpose) hang down into the water. *Salvinia* has in a remarkable degree the power of rising when submerged, of always rising with its leaves up and its roots down, and of rising with the upper surface of its leaves perfectly dry. It is obvious that these qualities are most useful to a plant which may be pressed under

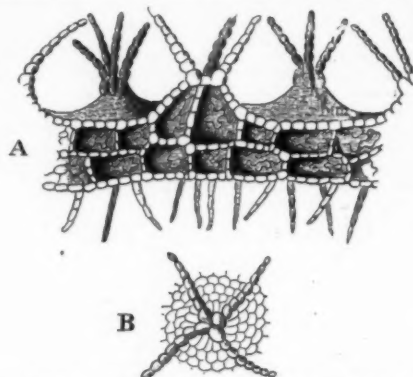


FIG. 2.—*Salvinia natans*. A, combined surface-view and section of floating leaf, modified from a figure in Sachs' "Botany," showing the air-cavities, the submerged hairs of the lower surface, and the groups of stiff hairs on the upper surface. These latter inclose spaces into which water cannot enter, even when the leaf is completely submerged. B, one group of hairs from the upper surface, seen from above.

water or drenched with rain. Its nutrition, like that of all green plants, depends largely upon substances extracted from the air; and to be overspread with water, which disappeared only by a slow process of evaporation, would be disadvantageous, especially if the water were not absolutely clean. Every leaf of *Salvinia* is, to begin with, excavated by a double layer of air-spaces, which lodge so much air as to give it great buoyancy. On the

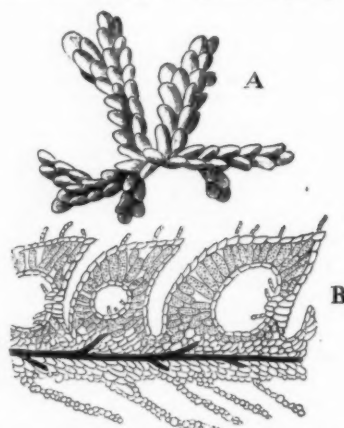


FIG. 3.—*Azolla caroliniana*. A, stem with leaves, magnified; B, longitudinal section through part of ditto, highly magnified. The air-cavities of the leaves are shown, the narrow spaces between the leaves, into which water cannot enter, the fine hairs of the upper surface, the submerged leaf-lobes, and the vascular bundles.

upper surface are placed at regular distances a number of prominences, each surmounted by a group of about four stiff, spreading hairs, which keep the water from reaching the surface of the leaf. When forcibly depressed, the *Salvinia* takes down with it a layer of air, which forms a flat bubble over the leaf, and of course gives great power of self-righting, for the specific gravity of the upper

side is greatly reduced, while the lower side is weighted, as before, by the long, water-logged roots. Once restored to the surface, the bubble bursts, and the little drops into which it is instantly resolved roll off like drops of quicksilver. Azolla, which is found in most hot countries, and is often grown in hothouses, behaves in a very similar way. Here the leaves are far smaller, and crowded together upon a branching stem of minute size. There are a few hairs upon the upper surface, and between the leaves are narrow clefts, connected with globular cavities, which occupy the centre of every leaf. These cavities, which are often closed, and never possess more than an outlet of extreme minuteness, are always filled with air; so are the clefts between the leaves. No water can lodge on the upper surface, apparently because the surface-film is stretched from the raised edge of one leaf to that of the next; and thus buoyancy, self-righting, and repulsion of water are efficiently secured.

Many plants which ordinarily float on the surface of the water (*Salvinia*, *Azolla*, *Duckweed*, *Potamogeton natans*, &c.) sink on the approach of winter. At this time it is very curious to see how completely they lose both their buoyancy and their power of repelling water. I do not know how this change is brought about, but the result is one of obvious advantage. The leaves, or in some cases the entire plants, sink to the bottom, and hibernate there, out of the reach of frost. Many perish; some are broken up by decay into isolated buds. When spring returns, the few survivors float up, and soon cover the surface with leaves. It would be interesting to know something of the mechanism by which these seasonal changes are effected.

One of the commonest objects in Nature, which is apt to escape our notice on account of its minute size, for it is less than one-quarter of an inch in length, is the egg-raft of the gnat. This was beautifully described 150 years ago by Réaumur. The eggs of the gnat are cigar-shaped, and 250 or 300 of them are glued together, so as to make a little concave float, shaped like a shallow boat. The upper end of each egg is pointed; the lower end is provided with a lid, through which the larva will ultimately issue into the water. The gnat in all stages, even while still in the egg, requires an ample supply of air. It is therefore necessary that the egg-raft should float at the surface; it is also necessary that it should always float in the same position, so as to facilitate the escape of the larva. This is effectually secured by a provision of almost amusing simplicity. Let us first notice how efficient it is. If we take two or three of these tiny egg rafts, and place them in a jug of water, we may pour the water into a basin again and again; every time the egg-rafts float instantly to the surface; and the moment they come to the top, they are seen to be as dry as at first. The fact is that the surface-film cannot penetrate the fine spaces between the pointed ends of the eggs. The cavity of the egg-raft is thus overspread by an air-bubble, which breaks the instant it comes to the top. The larva of the gnat, when it escapes from the egg, floats at the surface, and it is enabled to do so in consequence of the properties of the surface-film. When the larva changes to a pupa it becomes buoyant, and floats at the surface, except when alarmed. To enable it to free itself without unnecessary effort from the surface of the water, the respiratory tubes of the pupa are furnished with a valvular apparatus, which can cut the connection with the air in a moment, and restore it at pleasure, when the pupa again floats to the surface.¹

Another Dipterous insect, whose larva inhabits rapid streams, makes an ingenious use of the properties of the surface-film. This is the larva of *Simulium*, of which I have given some account in the lecture just quoted. At

the time of the delivery of that lecture, I was wholly unable to explain how one difficulty in the life of the insect is surmounted. The larva clings to the water-weeds found in brisk and lively streams. The pupal stage is passed in the same situation. But a time comes when the fly has to emerge. Now the fly is a delicate and minute insect, with gauzy wings. How does it escape from the rushing water into the air above, where the remainder of its life has to be passed? This was a question upon which I had spent much thought, but in vain. It appeared to me for many months completely insoluble. However, I was informed last year by Baron Osten Sacken of a paper written by Verdat, seventy years ago, in which the emergence of the fly of *Simulium* is described. Guided by Verdat's description, I had little difficulty in seeing for myself how the difficulty is actually overcome. During the latter part of the pupal stage, the pupa-case becomes inflated with air, which is extracted from the water, and passed through the spiracles of the fly into the space immediately within the pupal skin. The pupal skin thus becomes distended with air, and assumes a more rounded shape in consequence. At length it splits along the back, in the way usual among insects, and there emerges a small bubble of air, which rises quickly to the surface of the water and there bursts. When the bubble bursts, out comes the fly. It spreads its hairy legs, and runs upon the surface of the water to find some solid support up which it can climb. As soon as its wings are dry, it flies to the trees or bushes overhanging the stream.

A very interesting inhabitant of the waters, which makes use of the properties of the surface-film to construct for itself a home beneath the surface, is the water-spider (*Argyroneta aquatica*). This interesting little animal has been described by many naturalists, some of whom, judging from their accounts, had no personal acquaintance with its habits. But among the number is the eminent naturalist Félix Plateau, son of the physicist to whom we are so much indebted for our knowledge of the phenomena of surface-tension. I need hardly say that in his account of the water spider, Prof. Plateau gives a full and adequate account of the scientific principles concerned in the formation of its crystalline home.¹ Plateau remarks that the water-spider, like most other spiders, is an air-breathing animal. It dives below the surface, and spends nearly its whole life submerged. In order to do this without interruption to its breathing, the spider carries down a bubble of air, which overspreads the whole abdomen as well as the under side of the thorax. These parts of the body are covered with branched hairs, so fine and close that the surface-film of water cannot pass between them. The spider swims on its back, and the air lodges in the neighbourhood of the respiratory openings, which are placed on that surface which floats uppermost. When the spider comes to the top, as it does from time to time to renew its supply of air, it pushes the abdomen out of the water, and we can then see that this part of the body is completely dry. When it sinks, the water closes in again at a little distance from the body, and the bubble forms once more.

It would be inconvenient to the water-spider to be obliged to come frequently to the surface for the purpose of breathing. A predatory animal on the watch for its victims must lie in ambush close to the spot where they are expected to appear, and the water-spider accordingly requires a lurking-place filled with air, beneath the surface of the water. It has its own way of supplying this want. Relying on the fact, already illustrated by our muslin bag, that the surface-film of water will not readily pass through small openings, the spider proceeds as follows. It begins by drawing together some water-weeds with a few threads, in such a way that they meet at one or more points. It then fetches from the surface a fresh supply of air, and

¹ The larva and pupa of the gnat are more fully described in my British Association lecture on "Some Difficulties in the Life of Aquatic Insects," reported in *NATURE*, vol. xlv. p. 457.

¹ "Observations sur l'Argyronète aquatique," *Bull. Acad. Roy. de Belgique*, 2me. sér., tom. xxiii., 1867.

squeezes part of it out by pressing together the bases of its last pair of legs. The bubble rises, but is detained by some of the threads previously spun across its path. Then the spider returns to the surface to fetch another bubble, and repeats the operation as often as is necessary. Now and then she secures the growing bubble by additional threads, and before long has a bubble nearly as big as a walnut, inclosed within an invisible silken net, which imprisons the air as effectually as a dome of glass would do. The spider takes care to conceal her home from observation, and before long the minute *Algæ*, growing all the more vigorously because of the air brought to them, effectually conceal the habitation. The mouth of the dome, which is of course beneath, is narrowed to a small circle, and Plateau has observed a cylindrical horizontal tube, seven to eight millimetres in diameter, by which the spider is enabled to enter or leave her home without being observed. The air within is renewed as required, by the visits of the spider to the surface.

Besides this home, which is the ordinary lurking-place of the spider, another is required at the time when the young are hatched. The new-born spiders are devoid of the velvety covering of hairs, and would drown in a moment if placed in a nursery with a watery floor. The female spider therefore makes a special nest for this particular occasion, which floats on the surface of the water, rising well above it. It is bell-shaped and strongly constructed. The upper part is partitioned off, and contains the eggs. Beneath the floor of the nursery the mother takes her station, and watches over the safety of her brood, defending them against the predatory insects which abound in fresh waters. It is interesting to see how the faculty of spinning silk, used by the house-spider for her snares, and at other times for the fluffy cocoon in which the eggs are enveloped, furnishes to the water-spider the materials of her architecture. It is not less interesting to observe the economy of material which results from the use of the tenacious and contractile surface-film, in place of a solid wall.

We will next consider another property of the surface-film, which is turned to account in the daily life of the very commonest of our floating plants, I mean the duckweed, which overspreads every pond and ditch. A number of the green floating leaves of duckweed are now placed in a shallow dish in the field of the lantern, and I will ask you to observe how they are grouped. They have spontaneously arranged themselves in a very irregular fashion, forming strings and chains which spread hither and thither over the surface of the water. This is not the way in which most floating bodies behave. Let us remove the duckweed, and replace it by another dish of water in which I will put a number of small disks of cork.¹ You will see that the bits of cork are attracted one to another and crowd together in one place. Let us inquire why the floating bits of cork are thus attracted towards one another. If any solid capable of being wetted by water is partly immersed in water, the liquid rises round it in an ascending capillary curve. If the solid is not wetted by water, the curve will turn downwards. We may get ascending or descending capillary curves in other ways. If, for instance, I were to lay a sheet of paper upon water, and turn its edges up at certain places, we should get marked ascending curves at these points. The raising of some parts of the surface causes other parts to sink, and may bring about descending curves, or make previously formed descending curves more marked. We shall find it helpful in our experiments to notice one very simple plan of producing a descending capillary curve round the edge of a vessel. If we take a glass of water, and fill it until the water is level with the brim, we naturally speak of the glass as *full*; but if we are careful to avoid rude

shaking, we may still add a considerable quantity of water without spilling any. The glass will then become what we may call *over-full*, and its surface will be bounded by a descending capillary curve. Now, it is of immediate importance to us to observe that *like* capillary curves, whether ascending or descending, attract one another, and that *unlike* curves repel one another. The theoretical explanation of this point is not difficult, but it must not detain us here. To place the fact itself beyond dispute, we will try a little experiment. A circular dish of water is now placed in the field of the lantern, and we will introduce into it a small disk of wood. Both the disk and the side of the vessel are wetted by water, and an ascending capillary curve rises round each. The result is that the two bodies attract one another. Every time the disk is moved away it is powerfully drawn towards the side of the vessel. With a little syringe we will add water to the dish in sufficient quantity to raise the level above the edge of the vessel. You will observe that the wooden disk is now repelled by the edge of the vessel, and floats free in the centre. By sucking up a little water, it becomes attracted once more, and so we may go on, causing it to be attracted or repelled, according as we add or subtract a small quantity of water. But what has all this to do with the duckweed? In order to explain the behaviour of duckweed, I must ask you to examine a careful representation of its form. This common plant has not, to my knowledge, been faithfully represented in any botanical book. You will see that the leaf is of an irregular oval shape, broader at one end than at the other, and that the narrow end is pointed. A raised ridge extends along the length of the leaf, from the point to the middle of the opposite or rounded border. Duckweed almost invariably propagates itself by budding. New leaves are pushed out symmetrically on each side of the point. They grow bigger and bigger, and gradually free themselves. The point upon each leaf marks the place where it was last attached to the parent leaf. Sometimes the budding is so rapid, that, before a fresh pair of leaves have become free, they have already budded out a second pair, which we may call the granddaughters of the parent leaf. The pointed end of the leaf, and also the opposite end of the ridge, are raised above the general level, and very marked capillary curves ascend from the general water-level to these points. The free edge of every bud is also raised above the general water-level, and a capillary curve ascends to meet it. Hence, when a number of leaves of duckweed are floating freely on water, they are powerfully attracted one to another at certain points, while at intervening points they are relatively inert. If you take a floating leaf of duckweed, and bring near it a clean needle or a pencil-point, or any similar object, provided that it is not greasy, you will see that the leaf is at once attracted towards the point, but it always turns itself so as to bring one of its ascending curves round to the needle or pencil. We all see in the lantern how readily a leaf of duckweed is made to rotate rapidly by causing a needle-point to revolve round it, without ever touching it. Let us now try to imitate the behaviour of the leaves by some rude models. I have here some elliptical paper floats, cut out with a pair of scissors, and having each of the pointed ends a little turned up. We place these one by one on the surface of the water, and you see in the lantern how they are attracted to one another, point to point, and how they form long chains, which have a tendency to break up into stars. It is the existence of such points of attraction on the margin of the leaves which causes the duckweed to form chains and strings, so long as there is any unoccupied surface in the pond. A moment's consideration shows how profitable this tendency is to the plant. Were the duckweed to crowd together like the floating bits of cork, the pressure towards the centre of any considerable

¹ In order to avoid the inconvenience caused by the attraction of the sides of the vessel, the dish should be over-full of water.

mass of plants would be so great that the new leaves budded out would find no room in which to expand; but, by virtue of one very simple provision, viz. the existence of inequalities of level along the edges of the leaves, clear spaces and lanes are left between the floating leaves, so long as any unoccupied space remains.

Long exposure to the air, especially in still weather, affects the life of duckweed in a material way. Dust and decaying organic substances give rise to a pellicle, which is most mischievous to floating plants; and I think I could show, if time allowed, how much the habits of duckweed have been altered thereby. But, apart from visible impurities, mere exposure to air gives, as Lord Rayleigh has taught us, a considerable degree of superficial viscosity to water. Hence, the leaves of duckweed, when the surface is contaminated, will tend to lie in whatever positions they may be thrown by accidental causes, such as wind, and the attractions due to capillarity will be more or less impeded. But the effect of the superficial viscosity will in time be overcome by the attractive forces, so that it probably does not in the long run greatly affect the distribution of the leaves over the surface of water.

Many other floating plants, but not all, behave more or less like duckweed, and for the same reason. As yet I know of none which space themselves quite so effectually, and the extreme abundance of the common duckweed, as well as its world-wide distribution, may be partly due to the completeness of its adaptation to capillary forces. Some dead objects may accidentally take a shape which causes them to spread out over water, but I have met with none which have particularly struck me. Floating natural objects, such as sticks or seeds, behave, in many cases at least, very differently, and become densely massed. My attention was first called to this subject by seeing how different was the grouping of duckweed from that of some seeds of *Potamogeton natans*, which were floating in the same pond.

The capillary forces which spread the leaves of duckweed or *Azolla* upon the surface of water are indirectly concerned in the transport of these and like plants to fresh sites. If we put a stick into water overspread with duckweed, we cannot fail to notice how the leaves cling to the stick. They cling in a particular way, which enables them to bear transport more safely. The wetted surface, for obvious physical reasons, is attracted to the wetted stick; and the water-repellent surface, which is that which best resists drying, is outwards. The tenacity with which duckweed clings to the legs of water-birds, and the position which it almost inevitably takes under such circumstances, may have a good deal to do with the safe transport of the plant to distant pools. It is not, I think, too much to say that the prosperity of duckweed depends very largely upon the capillary forces which come into play at the surface of water.

We have now exhausted our time, though I have been obliged to leave unnoticed many special adaptations of living things to the peculiar conditions which obtain on the surface of water. Had time allowed, I should have been glad to say something about the aquatic animals which creep on the surface-film as on a ceiling, and about the insects which run and even leap upon the surface-film without wetting their minute and hairy bodies.¹ All small animals and plants which float on water necessarily come into contact with the surface-film, and have to deal with the difficulties which result from it. We have seen that they generally manage in the long run to convert these natural difficulties into positive advantages.

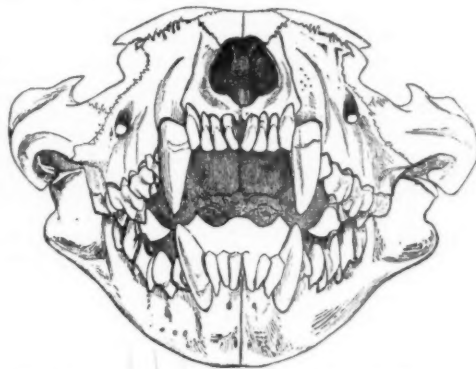
I have to thank my colleague, Dr. Stroud, for his frequent explanations of the physical principles upon which these adaptations depend, and also for much practical and valuable help in the preparation of suitable experiments.

¹ See NATURE, vol. xiv. p. 457.

THE DISCOVERY OF AUSTRALIAN-LIKE MAMMALS IN SOUTH AMERICA.

THE year 1891 proved a notable one in regard to marsupials. The existing mole-like marsupial (*Notoryctes*) from the deserts of Central Australia having been made known to us, news came of the discovery in the Tertiaries of Patagonia of remains of carnivorous marsupials closely allied to the existing pouched wolf, or Thylacine, of Tasmania. This discovery was immediately recognized as one likely to considerably modify some of our views regarding the distribution of mammals. A preliminary account of these new marsupials was given by Dr. Florentino Ameghino in a paper written for the new serial, *Revist. Argent. Hist. Nat.* This description seems to leave no doubt as to the correctness of the diagnosis of the fossil remains.

Before going further, it may be well to remind our readers that, with the single exception of the opossums (*Didelphyidae*) of America, all marsupials are now exclusively Australasian. The carnivorous types, such as the Thylacine (*Thylacinus*) and the Tasmanian Devil (*Sarcophilus*), are distinguished from all living mammals in that their upper cutting-teeth (incisors) are either four or five in number on either side, while in the lower jaw there are invariably three. This relation is shown in the figure of the skull of the Tas-



Front view of the skull of the Tasmanian Devil. (After Flower.)

manian Devil—a near ally of the Thylacine—where, between the large tusks of the upper jaw, we see the four pairs of incisors opposed to only three pairs in the lower jaw. In ordinary mammals, on the other hand, the number of pairs of incisors in each jaw does not exceed three, the number of those in the two jaws being usually equal. A further peculiarity of marsupials is that the cheek or grinding teeth comprise four true molars and not more than three premolars; whereas in ordinary mammals the typical number is three molars and four premolars, there being no known instance of the presence of four true molars except in some individuals of the fox-like *Otocyon*. Another peculiarity of most marsupials is the distinct inflection of the lower posterior extremity, or “angle,” of the lower jaw, while very frequently the bony palate of the skull has unossified spaces.

The new forms described by Dr. Ameghino were obtained from the lower part of that great series of freshwater formations with which so large an area of South America is covered. It has been inferred that the Patagonian deposits in question are as old as the Lower Eocene of Europe; but, although they are undoubtedly of considerable age, this inference can scarcely be regarded as an established

fact, since the occurrence of mammals allied to those of the European Lower Eocene is quite capable of explanation by their survival to a later period in South America.

One of the new Patagonian forms, to which Dr. Ameghino applies the name *Prothylacinus*, is stated to be an animal of the general conformation of the Thylacine, having apparently the same number of teeth, although the upper incisors are unknown. The main distinction of the fossil genus is, indeed, said to consist merely in the circumstance that the lower premolars are more widely separated from one another; the molars of the two forms being described as absolutely identical in character. The fossil likewise exhibits the marsupial inflection of the angle of the lower jaw. The absence of the upper incisors in the specimens of *Prothylacinus* is fortunately compensated in another genus described under the uncouth name of *Protoprovierra*. Here we find that the number of teeth is exactly the same as in the Thylacine, there being four upper and three lower incisors, a canine, three premolars, and four molars on each side of the skull. This dentition agrees numerically with that of the Tasmanian Devil; with the exception that there is an additional premolar in each jaw. These fossils also exhibit the inflection of the angle of the mandible, and the presence of unossified vacuities in the palate, which we have seen to be marsupial features.

As might have been expected to be the case, Dr. Ameghino also states that there appears to be a complete passage from these marsupial forms to others belonging to that group of primitive carnivores known as Creodonts, of which the European Upper Eocene *Hyænodon* and *Pterodon* are well-known examples. Now, if we are to trust these descriptions (and there appears every reason why we should), we must admit that *Prothylacinus* and *Protoprovierra* are veritable marsupials of an Australian type. Then comes the question, How are we to explain the occurrence of such closely allied forms in areas so remote from one another as Patagonia and Australia?

It had long ago been urged that the occurrence of carnivorous marsupials in South America and Australia and nowhere else (at the present time) indicated a former connection between those two areas. To this, however, Mr. Wallace ("Distribution of Animals," vol. i. p. 399) objected that the American opossums (*Didelphyidae*) were not an Australian type, and that they occurred in the Tertiaries of Europe; and hence he argued that both the American and Australian marsupials probably took their origin from the presumed marsupials of the European Jurassic rocks. This explanation, on Mr. Wallace's own showing, will not, however, hold good for the close resemblance stated to exist between the American *Prothylacinus* and the Tasmanian Thylacine, since it is quite impossible to believe that two such similar forms could have maintained their likeness in such remote regions after having diverged from a common European ancestor as far back as the Jurassic period.

It has, however, been long known that there are certain very remarkable relationships between the fauna and flora of all the great southern continents. For instance, among mammals, the rodent family *Octodontidae* is peculiar to South (including Central) America and Ethiopian Africa. Then, again, among fishes, the family of the *Chromidae* is confined to the rivers of South America and Africa, with one outlying genus in India; while the true mud-fishes (*Lepidosiren* and *Protopterus*) are solely South American and Ethiopian, the third representative of the same family being the *Baramunda* (*Neoceratodus*) of Queensland. Again, the connection between the flora of Africa and that of Western Australia is so intimate as to have induced Mr. Wallace (*op. cit.*, p. 287) to express his belief that there must have been some kind of land connection, although not necessarily a continuous one, between these two widely distant areas.

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The connection between the fauna of India and that of Ethiopian Africa is now too well known to stand in need of comment. The matter does not, however, end here; for if we go back to the Mesozoic epoch there are equally striking evidences of the connection between the faunas and floras of the southern continents. For instance, the extinct saurian genus *Mesosternum*, which appears to have been allied to the Plesiosaurs of the Lias, is known from early Secondary strata in Brazil and South Africa, and nowhere else. Then, again, the remarkable Anomodont reptiles (*Dicynodon*, &c.) of South Africa are closely connected with those of India; while the respective alliances between the Labyrinthodont amphibians and the Mesozoic floras of South Africa, India, and Australia are too well known to need more than mention.

It appears, then, that, altogether apart from the new discovery, the common factors connecting the faunas and floras of the four great southern prolongations of the continental land of the globe undoubtedly point, not only to a more or less intimate connection between these several areas, but also to their more or less partial isolation from the more northern lands.

Reverting to the new discovery, it may be observed that our comparatively intimate acquaintance with the Tertiary faunas of Europe and North America renders it in the highest degree improbable that marsupials of an Australian type lived during that time in either of those areas. It is, however, quite possible that they may turn up at any time in Tertiary formations in Africa, while there is nothing to show that they may not also have existed in peninsular India. Indeed, if we put aside as improbable any connection by way of the Pacific between South America and Australia, it seems impossible to give any explanation of the occurrence of allied marsupials in Patagonia and Australia without the assumption that their ancestors existed in some part of the great area lying between eastern South America and Western Australia.

R. LYDEKKER.

PHOTOGRAPHY IN COLOURS.

THE *Comptes rendus* for February 2, 1891, contained a brief note on colour photography, describing the method employed by M. G. Lippmann, who had been able to produce photographically the image of the spectrum with all its colours. A summary of this note was given in NATURE at the time (see vol. xlviii., p. 360).

M. G. Lippmann, who has been continuing his researches, has communicated further results, which appear in the *Comptes rendus* for April 25 (No. 17, vol. cxiv.). These results show that we are not far off the solution of a question which has been the aim of all the latest photographic researches. The following is a translation of the note in question:—

In the first communication which I had the honour to make to the Academy on this subject, I stated that the sensitive films that I then employed failed in sensitiveness and isochromatism, and that these defects were the chief obstacle to the general application of the method that I had suggested. Since then I have succeeded in improving the sensitive film, and, although much still remains to be done, the new results are sufficiently encouraging to permit me to place them before the Academy.

On the albumen-bromide of silver films rendered orthochromatic by azalin and cyanin, I have obtained very brilliant photographs of spectra. All the colours appear at once, even the red, without the interposition of coloured screens, and after an exposure varying from five to thirty seconds.

On two of these *clichés* it has been remarked that the colours seen by transmission are very plainly complementary to those that are seen by reflection.

The theory shows that the complex colours that adorn natural objects ought to be photographed just the same as the simple colours of a spectrum. There was no necessity to verify the fact experimentally. The four *clichés* that I have the honour of submitting to the Academy represent faithfully some objects sufficiently diverse, a stained glass window of four colours, red, green, blue, yellow; a group of draperies; a plate of oranges, surmounted by a red poppy; a many-coloured parrot. These showed that the shape is represented simultaneously with the colours.

The draperies and the bird required from five to ten minutes' exposure to the electric light or the sun. The other objects were obtained after many hours of exposure to a diffuse light. The green of the foliage, the grey of the stone of a building, are perfectly produced on another *cliché*; the blue of the sky, on the contrary, was represented as indigo. It remains, then, to perfect the orthochromatism of the plate, and to increase considerably its sensibility.

NOTES.

THE Royal Society's *soirée* is being held as we go to press. We hope to give next week some account of the principal objects exhibited.

THE Bureau des Longitudes is sending an expedition to Senegambia to observe the total solar eclipse of April 1893.

THE first session of the Institution of Mining and Metallurgy is to be held in the theatre of the Geological Museum, Jermyn Street, on Wednesday, May 18, when the President, Mr. George Seymour, will deliver the inaugural address. There will be an inaugural supper at the Criterion.

At the Royal Academy dinner Sir John Lubbock responded for science. He said that no class derived more benefit and enjoyment from works of art than men of science. Sir John referred also to the growing importance of art in relation to the material prosperity of the country. Our merchants and manufacturers, he said, could no longer rely entirely on excellence of material and solidity of workmanship, but had to look to artistic charm and beauty of design.

At the annual meeting of the Royal Institution on May 2, the following gentlemen were elected officers for the ensuing year: the Duke of Northumberland, President; Sir James Crichton-Browne, Treasurer; Sir Frederick Bramwell, Secretary.

It is reported from Melbourne that Sir Thomas Elder has decided not to send out another exploring expedition into Central Australia at present. He attributes the failure of his recent expedition, under Mr. Lindsay, to the severity of the season, the drought having been unusually trying.

ON May 7 the members of the Geologists' Association will make an excursion to Walthamstow, Mr. J. Walter Gregory acting as director. The object of the excursionists will be to examine sections on the Tottenham and Forest Gate Railway. The best section is about half a mile from St. James's Street, and shows the lower terraces of the Lea Valley gravels resting on a very eroded surface of London Clay. Masses of the London Clay stand up, which were probably once islets. The alterations in the position of the bed of the Lea are well shown by this cutting.

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ON Tuesday next (May 10) Mr. Frederick E. Ives will begin a course of two lectures at the Royal Institution on photography in the colours of nature.

At the meeting of the Franklin Institute, Philadelphia, on March 16, Mr. John Carbutt made some remarks on the results achieved by Mr. Frederick E. Ives in the field of colour photography, which, in his judgment, so far as practical results were concerned, were far in advance of anything that had as yet been accomplished elsewhere. Mr. Carbutt urged that it was eminently fitting for the Institute to recognize the value of the work of one of its own members, and moved that the subject of Mr. Ives's investigations and results in the field of colour photography should be referred to the committee on science and the arts for investigation and appropriate recognition. The motion was carried.

SIR JAMES CRICHTON-BROWNE delivered the annual oration at the 118th anniversary meeting of the Medical Society of London, held on Monday evening. He chose as his subject "Sex in Education." He showed that the female brain is lighter than that of the male, not only absolutely, but relatively to the respective statures and weights of the two sexes; that the specific gravity of parts of the female brain is less than that of corresponding parts of the male brain; and that the blood supply, which in the male is directed more towards the portions which are concerned in volition, cognition, and the ideomotor processes, is in the female more directed towards portions which are mainly concerned in the discharge of sensory functions. Sir James urged the necessity of such structural differences being taken into account in the conduct of education; and, while disclaiming any intention of bringing a wholesale indictment against high schools for girls, he nevertheless held that some of their methods were capable of leading to great evils, especially when not controlled by a judicious and sympathetic mistress. He pointed out the difficulty of obtaining trustworthy information as to either the methods of many schools or their effects, more especially as the pupils themselves were often hostile to the inquiry; but he referred to one school at which he had been permitted to ascertain the facts, and in which he found that, out of 187 girls belonging to the upper and middle classes, well-fed and clad and cared for, and ranging from ten to seventeen years of age, as many as 137 complained of headaches, which in 65 instances occurred occasionally, in 48 frequently, and in 24 habitually. He cited the authority of Sir Richard Owen for the position that children have no business with headaches, and that something must be wrong in the school in which they frequently suffer from them. An account was given of the *modus operandi* of excessive brain work as a factor in the production of ill-health, and statistics were quoted to show the special liability of the female organism to disease at the period of life which the educator has seized on for his own. He attached great importance to loss of appetite, especially morning appetite, as a result of overstrain, and as one which was calculated to be itself the fruitful parent of other evils; and he strongly condemned the recent decision of the University of St. Andrews to open its classes in arts, science, and theology to women as well as to men, thus, as he declared, taking not a retrograde step, but a downhill step towards confusion and disaster. "What was decided amongst the prehistoric protozoa cannot be annulled by Act of Parliament; and the essential difference between male and female cannot be obliterated at a sweep of the pen by any *Senatus Academicus*."

THE weather during the past week has been unsettled generally, and showers of cold rain, hail, or sleet have occurred

in many districts. The day temperatures have been low, with sharp frosts at night; on April 29 the thermometer on the grass fell as low as 20° in London, and heavy snow fell at Wick. From official reports for the week ended April 30 the temperature was several degrees below the mean for the week in all districts, although the bright sunshine had exceeded the normal amount. Gales were experienced on our exposed north and west coasts, but for the most part the wind has been light. Bright aurora has again been seen at several places. On May 1 the thermometer rose to 60° or more at several inland stations, but this improvement was not maintained. The winds, which during a few days were northerly and north-westerly, again became easterly over the whole of the British Isles, with unsettled and unseasonable weather.

A SPECIAL meeting of the New England Meteorological Society was held in Boston on April 6, when the recommendation of the Council to transfer the weather service of the Society to the National Weather Bureau at Washington, with the object of forming a New England Weather Service under the direction of that Bureau, was formally ratified. The New England Weather Service will continue to gather and publish observations of temperature and rainfall, and the monthly *Bulletin* will be continued as heretofore. While that part of the Society's work, in which the greater number of persons is involved, is thus transferred to the New England Weather Service, the meetings and investigations of the Society will be continued as during the past eight years. Three meetings will be held annually, and the proceedings will be published in the *American Meteorological Journal*, while the investigations will be published in the *Annals of the Harvard College Observatory*. In the *Bulletin* for March, it is stated that it is the intention of the Weather Bureau to make a special study of thunderstorms during the coming summer. The observations are to be made in several States, from May to August inclusive.

THE Deutsche Seewarte (Hamburg) has recently issued an atlas of thirty-five charts, with introductory text, showing the physical conditions of the Indian Ocean, on a similar plan to that published for the Atlantic Ocean some years ago. The rich materials at the disposal of the Seewarte have been discussed by Dr. Köppen and others in every form that can be of use both to seamen and physicists. Several charts are devoted to the currents, temperature and specific gravity, winds and monsoons, while the magnetic elements have been specially investigated by Dr. Neumayer.

THE Indian journals received by this week's mails report that Mr. John Eliot, the Meteorological Reporter to the Government of India, has returned to Simla from Chaman and Murree, where he has been establishing new meteorological observatories.

ON Friday last Colonel J. F. Maurice, Professor of Military Art and History to the Staff College, read at the meeting of the Royal United Service Institution a most interesting paper on military geography. This he described as a science dealing with all those conditions of the surface of the world which affected armies, campaigns, and battles. He sought to show how in the case of each of the great European countries strategic methods are affected by geographical conditions.

OPINIONS are being expressed by scientific workers in India in favour of the making of systematic experiments with snake poison. The Committee for the Management of the Calcutta Zoological Gardens are constructing, from private subscriptions a snake-house with the most modern improvements, which will contain specimens of all the principal poisonous snakes in

the country. If the necessary funds were available, arrangements could be made to fit up a small laboratory in connection with the snake-house, for the purpose of conducting inquiries of all descriptions bearing upon the pathology of snake-bite and cognate subjects, and in future there would be no difficulty in arranging for the carrying out of any special experiments that might be required. It is understood that Dr. D. D. Cunningham, F.R.S., President of the Committee, would in that case be willing to take an active part in organizing and promoting such inquiries and carrying out such experiments, including the testing of the various alleged remedies for snake-bite which are from time to time brought to notice. A Calcutta paper, quoted by the *Pioneer Mail*, understands that if the Government of India will make a grant of Rs. 5000 towards this object, the Lieutenant-Governor will endeavour to meet the balance from Provincial funds.

THE well-known mycologist, Dr. Stephan Schulzer von Muggenburg, has just died at the age of ninety.

AT the coming "World's Columbian Exposition" at Chicago, it is proposed to have an exhibition of the "wild weeds" from all the States and Territories of the Union.

UNDER the editorship of Mr. E. M. Holmes a Catalogue has just been issued of the "Hanbury Herbarium" in the Museum of the Pharmaceutical Society. The collection consists of above 600 dried specimens of plants yielding products used in pharmacy, or believed to have medicinal properties, each specimen being labelled with its locality or the source whence it was obtained, and often accompanied by notes or extracts from letters of foreign correspondents. The collection was formed by the late Daniel Hanbury, F.R.S.; and, by the desire of his executors, who presented it to the Pharmaceutical Society, it is preserved in a separate room, known as the "Hanbury Room," on the premises of the Society in Bloomsbury Square.

THE second part of "Botanicon Sinicum," by Dr. Bretschneider, the learned physician to the Russian Legation in Peking, has just been issued in Shanghai in the Journal of the North China Branch of the Royal Asiatic Society. The work deals with the botany of the Chinese classics, the object being to identify as far as possible the plants mentioned in the writings of Confucius, Mencius, and the other great sages of ancient China. Dr. Bretschneider takes each name in succession, supplies all the information given by native commentators on these ancient writers, and by lexicographers; then he gives all that can be gleaned from Japanese authorities, and follows this by the identifications of European students; concluding with the results of his own study and observation. Those whom Dr. Bretschneider's labours for the past twenty-five years have taught to expect profound learning, research, and thoroughness from him will not be disappointed in this work.

AMONG the contents of the new number of the Journal of the Royal Horticultural Society are the interesting papers read at the Conference on asters and perennial sunflowers, held at Chiswick in October last. The proceedings of the Conference were opened by an address by Mr. J. G. Baker, which is now printed. In this excellent address, in which the general botanical outlines of the subject are sketched out, Mr. Baker mentions that aster as it stands at present contains 200 or 300 species, and is concentrated in the United States. Nearly all our garden Michaelmas daisies belong to the species that grow wild in the Eastern United States. There are forty species of aster in the Rocky Mountains and fifteen in California, most of which are different from the eastern species, and have not been brought into cultivation. The papers published with Mr. Baker's

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address are on the genus aster, by Prof. G. L. Goodale; the Michaelmas daisy as a garden plant, by the Rev. C. W. Dod; perennial sunflowers, by Mr. D. Dewar; and the culture of sunflowers, by Mr. E. H. Jenkins.

THE "University Extension" movement has spread to the United States. We learn from the *Botanical Gazette* that Prof. J. M. Coulter, President of the University of Missouri, is lecturing to large University Extension classes in Evansville and New Albany, Indiana, and Louisville, Kentucky. Each course includes twelve lectures on the general morphology and physiology of plants.

AUSTRALIANS have had bitter experience of the mischief which rabbits are capable of doing, and now they seem likely to have trouble of a similar kind from the introduction of foxes. An Australian journal, quoted in the May number of the *Zoologist* says that foxes have already spread over a wide area, and are most destructive both to lambs and poultry. They attain greater size and strength in Australia than in England, and the mild climate is highly favourable to the increase of their numbers. "It must be very disheartening," says the writer, "to all who have stock of any kind to lose, to find themselves confronted by some new enemy introduced by thoughtless or selfish persons. If some energetic steps are not soon taken, nothing can prevent the spread of foxes over the whole continent."

MR. D. L. THORPE writes from Carlisle to the *Zoologist* that starlings in that district often reproduce the notes of the oystercatcher and curlew with wonderful accuracy. On April 3 he was surprised to hear the call of the landrail; it appeared to be the familiar "crake-crake" of that bird undoubtedly, but on further investigation he ascertained that a starling was reproducing the call-note of the rail. The bird had remembered his lesson of last summer remarkably well. Mr. Thorpe also mentions that, during severe weather in January last, a friend of his (the Rev. H. A. Macpherson) was astonished one day to hear the call-note of the common sandpiper repeated with such nicety as to completely deceive him, until the starling was detected in the act of rehearsing this summer cry.

A CAPITAL lecture on Egyptian agriculture was delivered by Prof. Robert Wallace at the meeting of the Society of Arts on April 27, and is printed in the current number of the Society's Journal. Referring to the Tewfikieh College of Agriculture, Prof. Wallace says that it was named in honour of the late Khedive (Tewfik Pasha), who took a special interest in its success. It had its origin in a desire which sprang up little more than two years ago in the Egyptian Government to develop the agricultural resources of the country by calling in the aid of science. The result has been a success far beyond the most sanguine anticipations. During the first year of its existence the College contained about 60 students, selected from about 300 applicants, and the numbers of the second, the current year, which began last October, have not fallen off. A number of the sons of large land-owners have taken advantage of the instruction offered, and it is hoped by this means to spread in all directions a knowledge of improved varieties of crop plants, improved rotations, improved implements, and improved methods, not necessarily altogether new to the country, but deserving of being more widely known.

MR. W. F. LIESCHING, writing in the new number of the *Selborne Society's Magazine* on ants in Ceylon, says he saw one day a string of ants streaming forth, evidently in search of "pastures new." He flicked away the leader, and waited to see the result. An immediate halt was made by the foremost ants, and a scene of the utmost confusion ensued. The ants from behind kept arriving at the scene of the catastrophe, and there

was soon a black crowd of ants huddling and jostling one another. Some detached themselves from the main group and took a turn round, trying to find traces of their leader. At last the tail end of the line arrived, and after brief consultation they all started off again, and a line soon began to unravel itself from the tangled mass moving back to the hole from which the whole company had so lately started on "pleasure bound or labour all intent." While Mr. Liesching was watching the return journey, a leech stung his leg. He took the creature off, and put it down in the line of march. Ants will carry off a worm, why not a leech? It was, however, most amusing to see how carefully all avoided the leech.

HENRY BRUGSCH PASHA read an interesting paper on Lake Moeris at the meeting of the Société de Géographie Khediviale on April 8. He had just returned from a visit to the neighbourhood of the supposed site of the lake, so that the subject was fresh in his mind. The *Times* has given a good abstract of the paper. M. Brugsch said there was abundant monumental evidence that at a very early period of Egyptian history there existed near the plateau of Hawara an immense basin of water, which gave its name to a whole province, the Fayûm, or "lake district." In ancient times there were forty-two divisions or nomes of Egypt, each having its own capital, local government, and *cultus*, and all more or less worshipping Osiris. From these the Fayûm was excluded. It was divided like the parent country into nomes with their governors, and save in the necropolis at Hawara was given over to the worship of Sebak, the crocodile god. It was known in the hieroglyphs as To She, the lake district, which in Coptic became P-i-um, the maritime district, and survives to-day in the Arabic Fayûm. It is evident from the celebrated Fayûm papyrus, of which there are two copies, that the term Mer-ner, the great water or lake, was also applied to it; and perhaps herein lies the origin of the name "Moeris." The waters of this lake must have reached to the plateau of Hawara, the necropolis of the inhabitants of a town called Shed, on the site of which stands the modern city of Medinet-el-Fayûm. It was in ancient times a Royal residence, and contained a magnificent temple dedicated to Sebak, whose dimensions far exceeded those of the temples at Thebes. Tradition gives Amen-em-hat III. of the twelfth dynasty as the constructor of Lake Moeris, and his burial-place is the crude brick pyramid at Hawara; but fragments bearing the cartouches of Amen-em-hat I. and Usersten II., found near Medinet, would prove it of more ancient date. Moreover, it was hardly possible that a town of such dimensions as Shed would be built at any distance from water. A canal named Hune, or Hunet, cut from the Nile, fed the lake and provided for the needs of the city; the mouth of it was called in the hieroglyphs La Hune, "the opening of the canal," a name which survives in the modern "El-Lahûn." There is an interesting allusion to this "opening of the canal" in the celebrated Stela of Piankhi, written about the eighth century B.C. M. Brugsch also suggested that Ra-pa-ro-hunet, "the temple of the mouth of the canal," might give us the derivation of the word labyrinth.

WE have received the third number of *Natural Science*, the new monthly review of scientific progress. Among the contributors are Prof. G. Henslow, Mr. G. A. Boulenger, Sir J. W. Dawson, and Prof. W. C. Williamson.

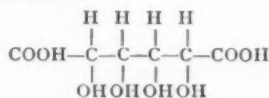
MESSRS. CHARLES GRIFFIN AND CO. have published the "Year-book of the Scientific and Learned Societies of Great Britain and Ireland." This is the ninth yearly issue. It presents lists of papers read before various Societies during the year 1891, together with information as to official changes. In most cases the Societies themselves have contributed the lists of papers. The names of those Societies concerning which no information has been received are shaded in the index only.

MESSRS. W. AND A. K. JOHNSTON have issued, under the authority of the Royal Agricultural Society of England, a valuable series of eight diagrams representing the life-history of the wheat plant. The diagrams are reproductions of original drawings by Francis Bauer, now in the Botanical Department of the British Museum, and are printed in colours. With each set is sent a pamphlet by William Carruthers, F.R.S., consulting botanist to the Society, entitled "The Wheat Plant: How it Feeds and Grows." This pamphlet consists of notes explanatory of the diagrams.

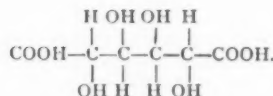
DR. L. MESCHINELLI AND DR. S. SQUINABOL announce for publication a Tertiary Flora of Italy.

FOUR lectures upon recent stellar spectroscopy and the new star in Auriga will be delivered in Gresham College, by the Rev. Edmund Ledger, at 6 p.m. on the evenings of May 10, 11, 12, and 13.

ANOTHER contribution to our knowledge of the sugars and their related compounds is published by Prof. Emil Fischer in the current number of the *Berichte*. It relates to the constitution of the group of substances at the head of which stands dulcitol, $\text{CH}_2\text{OH}-(\text{CHOH})_4-\text{CH}_2\text{OH}$, the hexahydric alcohol obtained from Madagascar manna, and prepared artificially by the reduction of milk sugar. It has already been established that the aldehyde corresponding to dulcitol is galactose, $\text{CH}_2\text{OH}-(\text{CHOH})_4-\text{COH}$, the glucose obtained from many gums, and which is formed when milk sugar is boiled with dilute acids. Moreover, it has long been known that, when either dulcitol or galactose are oxidized by means of nitric acid, a dibasic acid of the composition $\text{COOH}-(\text{CHOH})_4-(\text{COOH})$ is produced. This acid, although expressed by the same formula as saccharic acid, the acid obtained by the oxidation of common cane-sugar, differs considerably in properties from that acid, and has been termed mucic acid. It is now known to be a geometrical isomer of saccharic acid—that is to say, the two compounds only differ with regard to the relative positions of the atoms comprising their molecules. Saccharic acid, as obtained from cane-sugar, is probably unsymmetrically built up, for its solution rotates the plane of polarization of light to the left. The main result of the work now described has been to show that the molecules of mucic acid are, on the contrary, symmetrically constructed, and that its observed optical inactivity is due to this fact. Theoretical considerations, based upon the postulates of the Van 't Hoff-Wislicenus hypothesis concerning the arrangement of carbon, hydrogen, and oxygen atoms in space, lead to the view that, of the ten possible geometrically-isomeric dibasic acids of the constitution $(\text{CHOH})_4 \cdot (\text{COOH})_2$, two must be optically inactive. These two optically inactive isomers would be represented respectively by the formulæ



and



One of these two was presumably mucic acid. It was evident that if the molecules possessed a configuration similar to that roughly indicated in one plane by either of the above formulæ, upon reduction to a monobasic acid there would be an equal number of chances of each of the two end carboxyl groups being attacked by the reducing agent and converted to CH_2OH groups. Consequently it was to be expected that equal quanti-

ties of two geometrically isomeric monobasic acids would be obtained, one dextro- and the other lævo-rotatory. Such has, indeed, been found by Prof. Fischer to be the case; for, upon reducing either the ethyl ester or the lactone of mucic acid (the acid itself being unattacked) by means of sodium amalgam, an optically inactive acid of the constitution $\text{CH}_2\text{OH}-(\text{CHOH})_4-\text{COOH}$ was obtained, which formed a salt with strychnine yielding two distinct kinds of crystals, resembling the well-known complementary racemates of Pasteur. From these two kinds of crystals solutions of the free acids were obtained, which were respectively dextro- and lævo-rotatory, and each was again converted into mucic acid upon oxidation. One of these, the right-handed variety, was identical with the common galactonic acid prepared by oxidation of galactose. Moreover, by further reduction of the inactive acid, an inactive glucose was obtained, from which eventually common dextro- and also lævo-galactose were isolated by fermentation; and finally, by still further reduction of the galactose, dulcitol itself was obtained. Hence, the symmetrical structure of the dulcitol group may be considered as proved, and the work also completes the artificial synthesis of these compounds; for, given the synthesis of any one by the method previously described by Prof. Fischer, any of the others may be prepared from it by the processes now described.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*) from India, presented by Miss Beatrice Raymond; a Wild Swine (*Sus scrofa* ♀) from Tangiers, presented by Mr. E. H. Banfether; a Great Kangaroo (*Macropus giganteus*) from Australia, presented by Mrs. Frazer; a Purple Heron (*Ardea purpurea*), European, presented by Captain Woodward; a Bateleur Eagle (*Helotarsus ecaudatus*), a Tawny Eagle (*Aquila naevioides*) from Africa, presented by Captain Webster; a Raven (*Corvus corax*), European, presented by Mr. F. J. Stokes; seven Common Vipers (*Vipera berus*), British, presented by Mr. T. A. Cotton, F.Z.S.; a Rufous-necked Weaver Bird (*Hyphantornis textor*) from West Africa, purchased; an English Wild Bull (*Bos taurus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

SUN-SPOTS.—In the March number of the *Memorie della Società degli Spettroscopisti Italiani*, there are some interesting notes relating to spots and prominences. Prof. Tacchini gives a tabulated statement of the solar observations made at the Royal Observatory for the last three months of the year 1891. The most frequent records of faculæ occurred in the zones $\pm 10^\circ \pm 30^\circ$, only one being seen as high as the zone $+40^\circ + 50^\circ$. As regards the spots, the greatest frequency of groups took place in the zones $\pm 10^\circ \pm 20^\circ$, 23 and 10 being observed in the north and south respectively.

Profs. A. Mascari and J. Fenyi both contribute some notes on the large group of spots visible in February last, the latter pointing out that the relation of the eruption to the large group was such that its centre was situated very near the side of the great nucleus of the south spot, but was entirely outside the spot itself.

M. H. Deslandres records also his observations with respect to the remarkable protuberance visible on March 3 at about 10 a.m. From spectroscopic observations he obtained a radial velocity of 200 kilometres per second, using the hydrogen and helium lines. He also obtained a photograph of the invisible ultra-violet region, which furnished him with "an exact image" of this protuberance. The H and K lines were extraordinarily brilliant, and the negative contained the entire series of ultra-violet rays of hydrogen. It may be mentioned that at the appearance of this large protuberance no special indication was registered on the curves of the magnetic instruments which M. Deslandres obtained from M. Wolf.

Prof. Tacchini communicated to the Paris Academy on April 25 the results of solar observations made at the Roman College during the first three months of this year. Spots and

faculae were observed on 56 days, viz. 19 in January, 19 in February, and 18 in March. The results are shown below:—

1892.	Relative frequency		Relative magnitude	
	of spots.	of days without spots.	of spots.	of faculae.
January ...	19'63	0'00	79'79	56'58
February ...	23'31	0'00	153'61	60'28
March ...	13'12	0'00	61'67	86'39

The following are the results for prominences:—

1892.	Days of observation.	Mean number.	Mean height.	Mean extension.
January ...	13	6'39	39'6	1'6
February ...	13	7'00	36'0	1'6
March ...	14	8'14	36'4	2'3

The frequency and magnitude of spots during these months are much greater than during the preceding quarter, but prominences do not show a marked increase. No augmentation of this class of phenomena appears to have accompanied the great spot of February, if the mean numbers for the month be taken.

ECLIPSE OF THE MOON, MAY 11.—A partial eclipse of the moon will occur on May 11, and, if weather permits, it should be widely observed. The magnitude of the eclipse is 0'953, the moon's diameter being represented by 1. But although it is not total, important naked-eye observations can be made on the darkness of the shadowed moon for comparison with previous eclipses, and possessors of telescopes will doubtless take advantage of the occasion to obtain some new facts. The following times are from the "Nautical Almanac":—

	G.M.T.
First contact with the penumbra, May 11	h. m.
" " " shadow	9 10'2
Middle of the eclipse	10 53'4
Last contact with the shadow	12 36'6
" " " penumbra	13 50'9

The first contact with the shadow occurs at 82° from the most northern point of the moon's limb, counting towards the east; the last contact at 41° from the same point, counting towards the west.

SPECTRUM OF SWIFT'S COMET (α 1892).—Mr. W. W. Campbell observed the spectrum of Swift's comet on April 6, by means of a spectroscope having one prism of 60° attached to the 36-inch of the Lick Observatory (*Astronomical Journal*, No. 262). The spectrum could be distinguished from about C to G. Three bright bands had the wave-lengths of their less refrangible edges determined as 5630, 5170'4, and 4723, by comparison with spark-spectra of iron and magnesium. The intensities of the bands were estimated to be in the ratio 1:6:2.

COMET SWIFT, 1892. — *Astronomische Nachrichten*, No. 3087, contains the following ephemeris of Swift's comet:—

For 12h. Berlin Mean Time.					
1892.	R.A.	Decl.	log r.	log a.	B.
May 5	22 45 25	+23 41'7			
" 6	22 48 19	24 21'5			
" 7	22 51 12	25 0'5	0'0608	0'1115	0'70
" 8	22 54 3	25 38'7			
" 9	22 56 53	26 16'2			
" 10	22 59 41	26 52'9			
" 11	23 2 28	27 28'9	0'0723	0'1236	0'62

The brightness on March 10 is taken as unity.

On the 5th the comet will be found to form very nearly an equilateral triangle with the stars λ and μ in Pegasus, while on the 11th it will be near β in the same constellation.

COMET SWIFT, 1892.—The spectrum of this comet has been observed by Prof. Konkoly, who contributes his observations to the *Astronomische Nachrichten*, No. 3087. The spectrum on April 1 appeared very bright, and showed five bright lines whose intensities were as follows:—I. = 0'4; II. = 0'3; III. = 1'0; IV. = 0'2; V. = 0'1, the continuous spectrum extending from λ = 580 to λ = 440.

The following measures are the means of five direct scale readings of the above-mentioned lines:—

I. = 558'82 $\mu\mu$
II. = 544'94
III. = 516'30
IV. = 472'54
V. = 468'78

Similar observations were also repeated the next night, only by means of a larger telescope and spectroscope. The continuous spectrum was found to extend from λ = 559 $\mu\mu$ to λ = 449 $\mu\mu$. The intensities were I. = 0'5; II. = 0'3; III. = 1'0; IV. = 0'2; V. = 0'1.

The mean values of the five measures obtained for each line were:—

I. = 558'40 $\mu\mu$
II. = 543'82
III. = 516'26
IV. = 472'70
V. = 468'10

NOVA AURIGÆ.—*Astronomische Nachrichten*, No. 3083, contains some measurements and remarks by Prof. Konkoly relative to the spectrum of this Nova. Five lines were, according to him, very satisfactorily measured on March 20, and the means of six measures for each were as follows:—

I. = 531'80 $\mu\mu$
II. = 516'50
III. = 501'95
IV. = 492'30
V. = 486'15

Using a 10-inch objective prism on the 21st, he found that II. was the brightest line, III. being somewhat feebler; I. was very weak, while IV. was not bright, but broad; V., again, seemed quite visible. With regard to the dark lines, he was only able to suspect them in the region of C and F (especially the latter), owing to their feebleness. The hydrogen lines on the 21st appeared feebler than those in γ Cassiopeie.

A NEW VARIABLE.—A circular (No. 32) that we have received from the Wolsingham Observatory contains the following:—

The star D.M. + 55° 1870—

16h. 39m. 49s.; +55° 12'; 9'2

was found 7'3; 7'7, April 26; 29. Variable. Spectrum like Mira. T. E. ESPIN.

THE TEMPERATURE OF THE BRAIN.

THE Croonian Lecture was delivered this year by Prof. Angelo Mosso, Professor of Physiology in the University of Turin. His subject was the temperature of the brain, especially in relation to psychical activity. Prof. Mosso's earlier investigations on the human brain only related to the blood circulation.¹ He then found that the blood pressure rises during psychical work, and that during such more blood is sent from the peripheral parts of the body. Prof. Mosso also found that the blood circulation in the brain showed fluctuations which are not dependent on psychical activity. These and other variations in the brain circulation led him to suspect that Dr. Schiff's theory about brain temperature as introduced into physiology required revision. In a published work on fatigue,² Prof. Mosso gave his views on the influence of psychical work on the organism, especially on the muscular force. We do not yet know what form of phenomena subserves the first condition of thought. Fatigue caused by psychical activity acts as a poison, which affects all organs, but especially the muscular system. This is clearly demonstrated by Prof. Mosso's investigations on men who have been subjected to great mental strain. The blood of dogs, fatigued by long racing, acts as a poison, and when injected into other dogs they exhibit all the symptoms of fatigue. The characteristic phenomena of fatigue depend more on nerve-cell products than on a deficiency of suitable material.

During investigation into the physical conditions during psychical activity, Prof. Mosso's attention was directed to the subject of the temperature of the brain. To avoid errors arising from blood changes he endeavoured to keep the blood temperature and that of the organs in agreement with that of the brain. For such a purpose he found that the thermo-electric pile which Dr. Schiff employed would not suffice, and he had

¹ "Kreislauf des Blutes in menschlichen Gehirn," Leipzig, 1881.

² "Die Ermüdung," Leipzig, 1892.

therefore made by Baudin, of Paris, some very sensitive mercurial thermometers. The investigations made with the help of these instruments on the brain and blood temperatures bring to light new evidences of activity in the nerve centres. There are sometimes very extensive temperature developments under the influence of special excitements quite independent of psychical activity. The change in the nutrition of the nerve-cells, and not their specific activity, seems to be the most important source of heat in the brain. Thus Prof. Mosso would explain the marked effect on brain temperature of ordinary irritants where the increase is far higher upon the introduction of such than upon any psychical work done by the brain.

The following is an abstract of Prof. Mosso's Croonian Lecture:—

In his investigations on the temperature of the brain the author

that of the blood in the arteries. This is due to the very great radiation of heat which takes place from the surface of the head.

The brain when subjected to the action of the ordinary interrupted current rises in temperature. The rise is observed earlier in the brain than in the blood, and the increase is greater in the brain than in the general blood-current or in the rectum. During an epileptic seizure, brought on by electrical stimulation of the cerebral cortex, the author observed within twelve minutes a rise of 1°C. in the temperature of the brain.

As a rule the temperature of the brain is lower than that of the interior of the body; but intense psychical processes, or the action of exciting chemical substances, may cause so much heat to be set free in the brain that its temperature may remain for some time $0^{\circ}\cdot 2$ or $0^{\circ}\cdot 3\text{ C.}$ above that of the interior of the body.

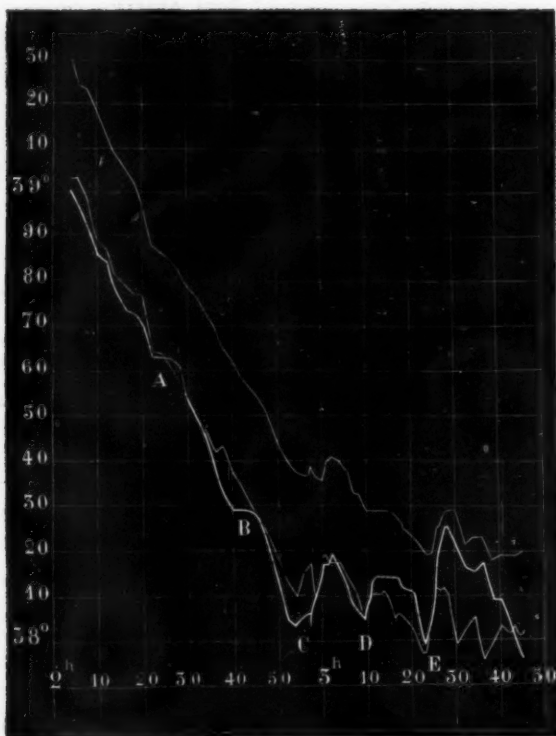


FIG. 1.—Dog rendered insensible with laudanum. The upper (thin) line represents the temperature of the interior of the body, the middle (thin) line the temperature of the blood in the carotid artery, the third (thick) line the temperature of the brain. A, injection of 3 c.c. laudanum; B, blast of a trumpet; C, D, E, electric stimulation of the brain. The ordinate is marked in tenths of a degree Centigrade, the abscissa in periods of ten minutes.

has employed, in preference to the thermo-electric pile, exceedingly sensitive mercurial thermometers, constructed specially for the purpose. Since each thermometer contains only four grams of mercury, the instruments respond very rapidly to changes of temperature, and a change of not more than $0^{\circ}\cdot 002\text{ C.}$ can easily be measured by means of them. The author has studied the temperature of the brain, comparing it with that of arterial blood, of the muscles, and of the interior of the body. His observations were made on animals under the influence of morphia or various anaesthetics, and also on man.

The curves of the observations made show that in profound sleep a noise, or other sensory stimulus, is sufficient to produce a slight development of heat in the brain, without the animal necessarily awakening.

In profound sleep the temperature of the brain may fall below

When a dog is placed under the influence of curare, the temperature of the brain remains fairly high, while that of the muscles and that of the blood falls. The difference of temperature thus brought about is great and constant. In one instance, the temperature of the brain was $1^{\circ}\cdot 6\text{ C.}$ above that of the arterial blood in the aorta. Such observations warn us not to regard the muscles as forming, *par excellence*, the thermogenic tissue of the body.

In order to show how active are the chemical processes in the brain, it is sufficient to keep the animal in a medium whose temperature is the same as that of the blood. When the effects of radiation through the skull are thus obviated, the temperature of the brain is always higher than that of the interior of the body, the difference amounting to $0^{\circ}\cdot 5$ or $0^{\circ}\cdot 6\text{ C.}$

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Observations made while an animal is awake tend to show that the development of heat due to cerebral metabolism may be very considerable, even in the absence of all intense psychical activity. The mere maintenance of consciousness belonging to the wakeful state involves very considerable chemical action.

The variations of temperature, however, observed in the brain, as the result of attention, or of pain or other sensations, are exceedingly small. The greatest rise of temperature observed to follow, in the dog, upon great psychical activity was not more than $0^{\circ}01$ C. When an animal is conscious, no

sensible by an anæsthetic, one no longer obtains a rise of temperature upon stimulating the cerebral cortex with an electric current. These results cannot be explained as merely due to the changes in the circulation of the blood. The physical basis of psychical processes is probably of the nature of chemical action.

In another experiment, in an animal rendered insensible with chloral, the curves of temperature show that when the muscles of a limb are made to contract, the temperature of the muscles rises, but falls rapidly as soon as the stimulation ceases, soon returning to the normal. This is not the case, however, with

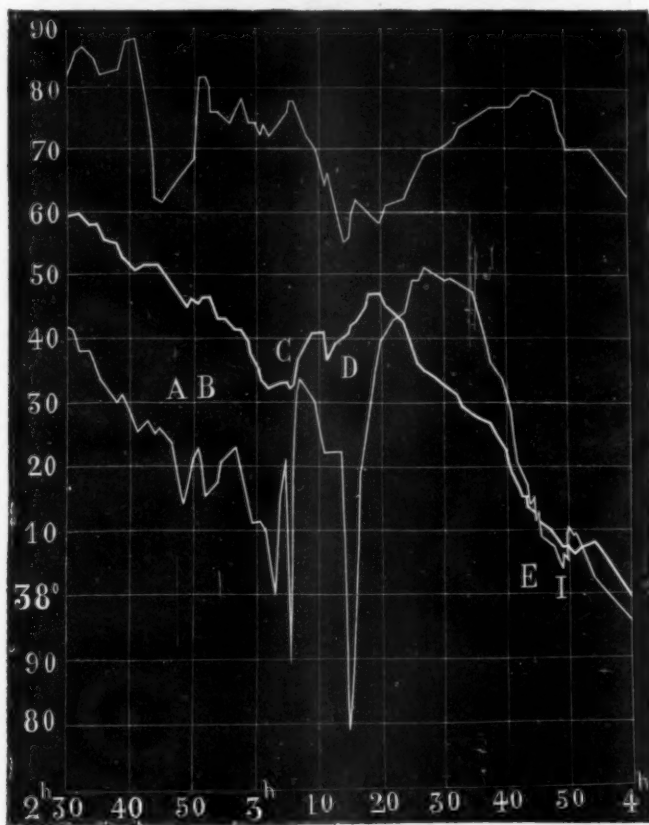


FIG. 2.—Dog (female) rendered insensible with chloroform and then with laudanum. The upper line represents the temperature of the vagina, the middle (thicker) line that of the brain, the lower that of the arterial blood in the carotid artery. A and B, psychical emotion; C, electric stimulation of the brain; D, injection of 14 c.c. laudanum (intravenous); E and I, electric stimulation of the brain.

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change of consciousness, no psychical activity, however brought about experimentally, produces more than a slight effect on the temperature of the brain.

The author shows an experiment by which it is seen that, as part of the effect of opium, the brain is the first organ to fall in temperature, and that it may continue to fall for the space of eighteen minutes, while the blood and the vagina are still rising in temperature.

The author discusses the elective action of narcotics and anæsthetics. He shows that these drugs suspend the chemical functions of the nerve-cells. In a dog rendered completely in-

the brain excited by an electric current. Here the stimulus gives rise to a more lasting production of heat; the temperature may continue to increase for several minutes after the cessation of the stimulation, indeed, often for half an hour. This may possibly explain why, upon an electric stimulation of the cerebral cortex, the epileptiform convulsions are not immediately developed, but only appear after the lapse of a latent period of several minutes.

This experiment may be made to show the elective action exercised upon the brain by stimulant remedies. The injection of 10 centigrams of cocaine hydrochlorate produces a rise of

temperature in the brain of $0^{\circ}36$ C., without any change in the temperature of the muscles or of the rectum being observed. In a curarised dog, the intervention of the muscles being thereby excluded, the action of the cocaine may produce a rise of as

the magnet was in oscillation, the force increasing, and reaching a maximum at 13h. 43m., after which it began to decrease, the minimum being reached at 0h. 15m. on the 14th. Further abrupt movements occurred at 4h. 30m. on the 14th, the oscil-

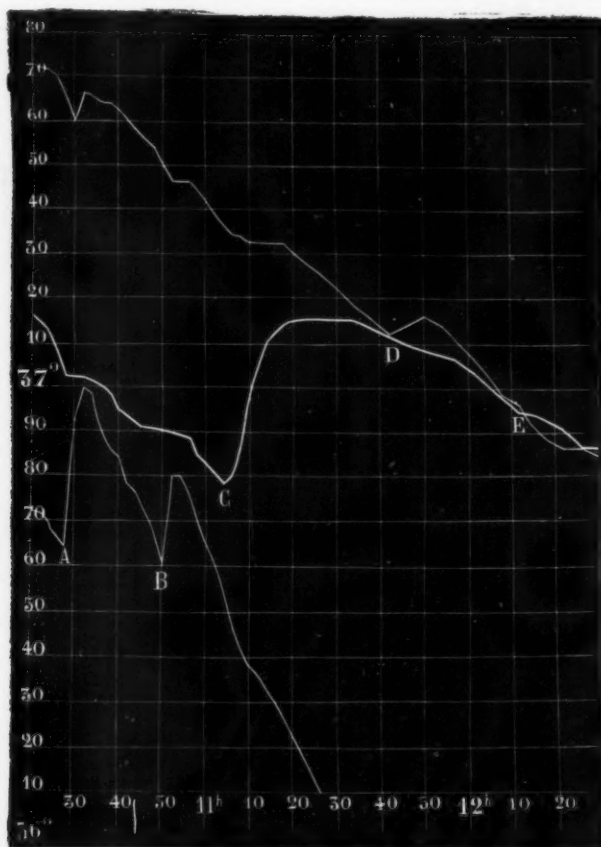


FIG. 3.—Dog rendered insensible with chloral. The upper line represents the temperature of the rectum, the middle (thicker) line that of the muscles of the thigh. A and B, electric stimulation of the muscles; C, injection of 10 centigrams of cocaine into the saphena vein; D, E, spontaneous variations in the temperature of the rectum.

much as 4° C. in the temperature of the brain, the author having observed a rise from 37° to 41° C. This shows that in arranging the calorific topography of the organism a high place must be assigned to the brain.

THE MAGNETIC STORM OF FEBRUARY IN MAURITIUS.

AT a meeting of the Meteorological Society of Mauritius, that took place on April 7, Mr. Meldrum read a short paper on the sun-spots, magnetic storm, cyclones, and rainfall of February 1892. The photographs of the sun that he exhibited, which were taken at the Royal Alfred Observatory from February 5 to 18, showed the very large group of spots, their approximate latitude on the 9th being from 6° to 16° south. Leading on to the occurrence of the great magnetic storm which began at 8h. 55m. on the 13th, he states that its commencement was distinctly recorded on the three curves, the horizontal force suffering the greatest disturbance. Up to 14h.

lations, as shown by the curves, being very numerous, but at 19h. the magnets became more steady, and were quiet by 3h. on the 15th. The ranges obtained at the Mauritius Observatory were the largest ever recorded there.

Cyclones were not absent during this month. One lasted from the 11th to the 14th, and another from the 25th to the 28th, while a third was also experienced on the 21st and 22nd, about 550 miles south of Mauritius. The rainfall for February, as shown by returns from the numerous stations, was from 4'30 to 16'96 inches above the average for periods of 7 to 29 years. At Antoinette the fall for the month amounted to 12'53 inches, while that at Cluny came to 34'37 inches. St. Aubin and Nouvelle France came in for a considerable quantity of rain, the falls in the 24 hours ending at 8 a.m. on the 13th reaching the figures 5'00 and 18'20 inches respectively. Referring lastly to the magnificent displays of aurora that have been observed both in Europe and America, he mentions that, although at Mauritius the sky was overcast, under similar conditions with respect to solar activity and terrestrial magnetism, a great display was visible in 1872: Mr. Meldrum,

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In his concluding remarks as to whether "there is a causal connection between solar activity (as indicated by outbursts on the sun) and magnetic disturbances, auroras, cyclones, and rain-fall," remarks that with regard to the two former there can hardly be any doubt, but with regard to the two latter he is of opinion that a very close connection does exist, there being a considerable preponderance of evidence in its favour.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—*Annual Abstract of Accounts*.—The abstract of accounts of the University for the year ending December 31, 1891, has just been published. It exhibits both the accounts of the Curators of the Chest and the financial position of the University institutions. The receipts show an income of £66,986 12s. 9d., against £65,175 17s. 2d. last year. The principal sources of internal income include estates £9978 12s. 8d., the University Press £5000, University dues £11,153 5s., examination fees £3569 1s., degree fees £9600. The Proctorial fines amount to only £313, nearly £100 less than last year. In connection with the present agitation against Proctorial jurisdiction this item is interesting. The total payments amounted to £64,557 6s. 3d. There was transferred to capital account £225 16s. 4d., and a balance carried forward of £203 10s. 2d. In this item of expenditure, we find institutions and public buildings cost £19,085, the largest item under this head being the Bodleian Library £7772 4s. 4d., while the Taylor Institution absorbed £2245. The expenses in connection with lectures in large towns amounted to £729 11s. 8d., and the interest and sinking fund on loans for University purposes came to £6157 8s. 4d.

The loans account shows that the amounts remaining to be paid are £36,000 at 4 per cent. on the £60,000 New Schools Loan, and £7666 13s. 4d. at 2½ per cent. on the £10,000 Physiological Laboratory Loan.

The University and the County Councils.—The report on the peripatetic teaching in scientific and technical subjects carried on in various country districts under the supervision of the Oxford Delegates for University Extension, acting in concert with the Technical Instruction Committees of County Councils during last winter, has just been published. The report states that the Oxford Delegates for University Extension were requested by the representatives of eight County Councils in England to provide for the delivery of 227 courses, embracing 2271 lectures, on chemistry, agriculture, geology, botany, veterinary science, physiology, and hygiene. These courses have been regularly attended by more than 10,000 persons in all grades of society.

The relations between the University Extension Committees of the different Universities and the County Councils, in reference to the matter of technical instruction, has now become so important, that a Conference was summoned last week, under the presidency of the Provost of Queen's College, to consider this connection, and to profit by the experience already gained, an experience, which in some cases extends over two years. It was felt that there are certain mistakes, inevitable in the commencement of any large scheme, which might be advantageously removed, so as to promote greater harmony, and possibly more economy in the fuller development of the scheme. Many organizing secretaries and others interested in the scheme attended the Conference, which extended over two days.

Two principal subjects were under discussion, first, the provision of summer courses of instruction in Oxford, Cambridge, and other University towns for teachers in elementary schools; secondly, the methods of organization of peripatetic teaching in regard to hours of lectures, classes, cost, and local management. In connection with the first point, it was announced that Oxford, Cambridge, and the Yorkshire College, Leeds, would be prepared to offer accommodation to students this summer; the Victoria University has, however, made no such provision. The method of procuring instruction in practical agriculture and experimental farming occupied much of the attention of the meeting, and much stress was laid upon the importance of securing the co-operation of farmers to look after the experimental stations.

On the matter of peripatetic teaching, it was felt by some that no very great assistance could be expected from the elementary teacher, and that reliance must be placed upon the teacher supplied by the Universities, in some cases advantageously supplemented by the teachers in secondary schools.

Not the least important feature in the Conference was the

anxiety displayed by all present to urge on to the utmost of their power the great work of the dissemination of technical and scientific instruction, influenced solely by disinterested motives for the public service.

CAMBRIDGE.—Prof. Bonney, F.R.S., Fellow of St. John's College, will this year deliver the Rede Lecture in the Senate House, on Wednesday, June 15, at noon. The subject is "The Microscope's Contributions to the Earth's Physical History."

The Adams Memorial Committee have issued a circular inviting contributions towards the erection of a monument to the late Prof. J. C. Adams in Westminster Abbey. These may be paid to one of the treasurers (Dr. Searle, Master of Pembroke, and Prof. Liveing), or to one of the secretaries (Dr. Porter, Master of Peterhouse, Dr. Donald MacAlister, St. John's, and Dr. Glaisher, Trinity), or to the account of the Adams Memorial Fund at Messrs. Mortlock's Bank, Cambridge. We do not doubt that the invitation will meet with a generous response from the admirers of the great astronomer.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 28.—"On a Decisive Test-case disproving the Maxwell-Boltzmann Doctrine regarding Distribution of Kinetic Energy." By Lord Kelvin, Pres. R.S.

The doctrine referred to is that stated by Maxwell in his paper "On the Average Distribution of Energy in a System of Material Points" (Camb. Phil. Soc. Trans., May 6, 1878, republished in vol. ii. of Maxwell's "Scientific Papers") in the following words:—

"In the ultimate state of the system, the average kinetic energy of two given portions of the system must be in the ratio of the number of degrees of freedom of those portions."

Let the system consist of three bodies, A, B, C, all movable only in one straight line, KHL:

B being a simple vibrator controlled by a spring so stiff that when, at any time, it has very nearly the whole energy of the system, its extreme excursions on each side of its position of equilibrium are small:

C and A, equal masses:

C, unacted on by force except when it strikes L, a fixed barrier, and when it strikes or is struck by B:

A, unacted on by force except when it strikes or is struck by B, and when it is at less than a certain distance, HK, from a fixed repellent barrier, K, repelling with a force, F varying, according to any law, or constant, when A is between K and H, but becoming infinitely great when (if at any time) A reaches K, and goes infinitesimally beyond it.

Suppose now A, B, C to be all moving to and fro. The collisions between B and the equal bodies A and C on its two sides must equalize, and keep equal, the average kinetic energy of A, immediately before and after these collisions, to the average kinetic energy of C. Hence, when the times of A being in the space between H and K are included in the average, the average of the sum of the potential and kinetic energies of A is equal to the average kinetic energy of C. But the potential energy of A at every point in the space HK is positive, because, according to our supposition, the velocity of A is diminished during every time of its motion from H towards K, and increased to the same value again during motion from K to H. Hence, the average kinetic energy of A is less than the average kinetic energy of C!

This is a test-case of a perfectly representative kind for the theory of temperature, and it effectually disposes of the assumption that the temperature of a solid or liquid is equal to its average kinetic energy per atom, which Maxwell pointed out as a consequence of the supposed theorem, and which, believed to be thus established, has been largely taught, and fallaciously used, as a fundamental proposition in thermodynamics.

It is, in truth, only for an approximately "perfect" gas—that is to say, an assemblage of molecules in which each molecule



moves for comparatively long times in lines very approximately straight, and experiences changes of velocity and direction in comparatively short times of collision—and it is only for the kinetic energy of the translatory motions of the molecules of the "perfect gas," that the temperature is equal to the average kinetic energy per molecule, as first assumed by Waterston, and afterwards by Joule, and first proved by Maxwell.

"Researches on Turacin, an Animal Pigment containing Copper; Part II." By A. H. Church, M.A., F.R.S., Professor of Chemistry in the Royal Academy of Arts, London.

This paper is in continuation of one read before the Society in May 1869 (Phil. Trans., vol. clix. pp. 627-36). It contains an account of observations made by other investigators on turacin and on the occurrence of copper in animals; a table of the geographical distribution of the Touracos, and a list of the twenty-five known species; a chart of turacin spectra (for which the author is indebted to the kindness of Dr. MacMunn); and a further examination of the chemical characters and the composition of turacin. The more important positions established by the present inquiry are these:—

1. The constant occurrence in eighteen out of the twenty-five known species of *Musophagide*, of a definite organic pigment containing, as an essential constituent, about 7 per cent. of copper.

2. The "turacin-bearers" comprise all the known species of the three genera, *Turacus*, *Gallirex*, and *Musophaga*; while from all the species of the three remaining genera of the family *Musophagide*—namely, *Corythæola*, *Schizorhis*, and *Gymnoschizorhis*—turacin is absent. Furthermore, the zoological arrangement of the genera constituting this family is in accord with that founded on the presence of turacin.

3. The spectrum of turacin in alkaline solution shows, besides the two dark absorption bands previously figured, a faint broad band on either side of line F, and extending from λ 496 to λ 475.

4. The spectrum of isolated turacin in ammoniacal solution shows, besides the three bands already named, a narrow fourth band, lying on the less-refrangible side of line D, and extending from λ 605 to λ 589. It probably arises from the presence of traces of the green alteration-product of turacin formed during the preparation of that pigment in the isolated condition; an alteration-product which is likely to prove identical with Krukenberg's turacoverdin.

5. Turacin in ammoniacal solution remains unchanged after the lapse of twenty-three years.

6. Turacin in the dry state, when suddenly and strongly heated, yields a volatile copper-containing red derivative, which, though undissolved by weak ammonia-water, is not only soluble in, but may be crystallized from, ether.

7. Turacin in the dry state, when heated in a tube surrounded by the vapour of boiling mercury, becomes black, gives off no visible vapour, is rendered insoluble in alkaline liquids, and is so profoundly changed that it evolves no visible vapour when afterwards strongly heated.

8. The accurate analysis of turacin offers great difficulty. The percentage composition, as deduced from those determinations which seem most trustworthy, is—

Carbon ...	...	...	...	53.69
Hydrogen ...	...	...	...	4.60
Copper ...	...	...	...	7.01
Nitrogen ...	...	...	...	6.96
Oxygen...	...	...	...	27.74

These numbers correspond closely with those demanded by the empirical formula $C_{22}H_{81}Cu_2N_3O_{32}$, although the author lays no stress upon this expression.

9. Turacin presents some analogies with hæmatin, and yields, by solution in oil of vitriol, a coloured derivative, turacoporphyrin. The spectra of this derivative, both in acid and alkaline solution, present striking resemblances to those of hæmatoporphyrin, the corresponding derivative of hæmatin. But copper is present in the derivative of turacin, while iron is absent from its supposed analogue, the derivative of hæmatin.

Chemical Society, April 7.—Dr. W. H. Perkin, F.R.S., Vice-President, in the chair.—The following papers were read:—The separation of arsenic, antimony, and tin, by J. Clark. The mixed sulphides of arsenic, antimony, and tin obtained in the ordinary course of quantitative analysis are dissolved in a strong solution of ferric chloride in hydrochloric acid, and the arsenic distilled off and weighed as trisulphide. The residual liquor contains the antimony as

trichloride, and the tin as stannic chloride, together with ferrous and ferric chlorides. Without removing the iron salts, the antimony is precipitated with hydrogen sulphide in a tepid solution containing from one-quarter to one-third of its volume of hydrochloric acid and a considerable quantity of oxalic acid. The precipitate, which is free from tin, is washed first with water, then with alcohol, and finally with carbon disulphide, and weighed as Sb_2S_3 after being dried at 130° . When the antimony precipitate is large, it must, after drying, be digested in carbon disulphide to extract the whole of the sulphur. To obviate this, the author reduces the excess of ferric chloride with thin sheet-iron, as soon as the yellow colour has disappeared the undissolved iron is removed, and the antimony which has come down is redissolved by cautiously adding ferric chloride till the solution is distinctly yellow, showing that all the tin is in the stannic state; a warm solution of oxalic acid containing about one-third of its volume of hydrochloric acid is then added, and the precipitated antimony trisulphide washed and weighed as above. After removal of the antimony, the hydrogen sulphide is expelled by boiling, the oxalic acid decomposed with potassium permanganate, the tin precipitated in hot solution with hydrogen sulphide, and allowed to stand till cold. The stannic sulphide thus obtained is filtered, washed, ignited, and weighed as SnO_2 .—Platinous chloride and its uses as a source of chlorine, by W. A. Shenstone and C. R. Beck. The authors have examined chlorine prepared from six specimens of platinous chloride of independent origin, and have found oxygen and hydrogen chloride to be present in them all. From these results they conclude that platinous chloride made by any of the processes hitherto recommended, including that lately suggested by L. Pigeon, contains a very perceptible quantity of some basic compound, which gives off water, together with the gases previously mentioned. It was also noticed that after mercury has been exposed to the action of chlorine, in the presence of a trace of water, it becomes capable of absorbing hydrogen chloride; it is not yet certain whether this action depends on the presence of oxygen or not.—Note on the adhesion of mercury to glass in the presence of halogens, by W. A. Shenstone. The author finds that carefully purified chlorine, bromine, and iodine affect mercury like ozone, causing it to adhere to glass in a remarkably perfect manner.—The decomposition of mannitol and dextrose by the *Bacillus ethacetici*, by P. F. Frankland and J. S. Lumsden. The authors find that the products of fermentation of both mannitol and dextrose by *B. ethacetici* consist of ethyl alcohol, acetic acid, carbon dioxide, hydrogen, and traces of succinic acid. A considerable quantity of formic acid is also formed when the fermentation proceeds in a closed space, whilst, in fermentations conducted in flasks merely plugged with cotton wool, formic acid, except in traces, is an exceptional product. This phenomenon has previously been found to occur with fermentations by means of *A. ethacetosuccinicus*. Formic acid is doubtless a primary product of the fermentation, but tends to break down into carbon dioxide and hydrogen. In the closed space, however, equilibrium is soon established between the formic acid and its decomposition products, and part of the formic acid is subsequently found in the solution. This view is supported by the fact that carbon dioxide and hydrogen are found in almost equal volume. The proportions in which the several products are obtained from mannitol are approximately represented by the equation— $3C_6H_{14}O_6 + H_2O = C_2H_4O_2 + 5C_2H_6O + 5CH_2O_2 + CO_2$.

In the case of dextrose the products occur in the proportion $2.5C_6H_{14}O_6 : 1.5C_2H_4O_2 : 3CH_2O_2 : CO_2$. There is a close qualitative and quantitative resemblance between fermentations by *B. ethacetici* and those occurring by means of the *Pneumococcus* (Friedländer), which renders it probable that this ethacetic decomposition is a very general and typical form of fermentative change.—The preparation of glycollic acid, by H. G. Colman. Glycollic acid may be readily prepared by boiling concentrated potassium chloracetate solution for 24-30 hours. The liquid is then distilled under reduced pressure, and the residue mixed with acetone. On evaporation of the filtered solution, glycollic acid crystallizes out in colourless crystals, containing only about 1 per cent. of ash. This acid would seem to be dimorphic. Glycollic anilide may be prepared by heating glycollic acid for some time to 240° , and boiling the product with aniline. Researches on silicon compounds and their derivatives; Part vi. The action of silicon tetrachloride on substituted phenylamines, by J. E. Reynolds. Diphenylamine combines with silicon tetrachloride to form an unstable addition compound.

which is decomposed below the boiling-point of benzene. Ethylaniline is easily acted on by the tetrachloride, ethylaniline hydrochloride separates, and a compound having the composition $\text{Si}(\text{PhNEt})_4$ is formed. Diethylaniline is but feebly acted on by silicon tetrachloride; the compound PhNEt_2HCl is formed, and probably a substance of the composition $\text{Si}(\text{C}_6\text{H}_5\text{NEt})_4$.—Chemistry of the compounds of thiourea and thiocarbimides with aldehyde-ammonia, by A. E. Dixon. The alkyl and allied thiocarbimides react with aldehyde-ammonia, in accordance with the following equation—

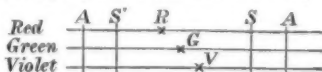


It was suggested that some connection might exist between the class of substances so formed and the compounds obtained by the action of thiourea on the aldehyde-ammonias. From the great similarity in behaviour of the compounds derived from the two sources, the author infers that they are members of the same class. Though thiourea and aldehyde-ammonia readily interact, it was found impossible, under any conditions, to cause substituted thioureas to act on aldehyde-ammonia. The author considers that this fact indicates that the monosubstituted

thioureas are of the form $\text{HN}:\text{C} \begin{matrix} \text{NH}_2 \\ \text{SH} \end{matrix}$ and not $\text{CS} \begin{matrix} \text{NH}_2 \\ \text{NHR} \end{matrix}$.

—The atomic weight of boron, by J. L. Hoskyns-Abrahall. The deceased author determined the atomic weight of boron by estimating the amount of silver necessary to precipitate the bromine from a known weight of boron bromide. The mean atomic weight obtained is 10.816 ± 0.0055 . Silver is taken as 107.923, and bromine as 79.951.

Physical Society, April 8.—Dr. J. H. Gladstone, F.R.S., Past President, in the chair.—Mr. Walter Baily read a paper on the construction of a colour map. By the term "colour map," the author meant a diagram, each point of which defines by its position some particular colour. Captain Abney had shown that all colours, except the purples, could be formed by adding white light to some spectrum colour, whilst all except the greens could be made to produce white by the addition of some spectrum colour. There were, therefore, two ways in which colours, other than greens and purples, could be indicated. In one of these, the ordinate of a point might represent the spectrum colour by its wave-length, and the abscissa, measured to the right of a vertical spectrum line, the amount of white light to be added to the spectrum colour to produce the colour represented by the point. In the other, the abscissa of a point situated on the left of the spectrum line represents the quantity of white light produced by the addition of the spectrum colour to the colour indicated by the point. Regarding the spectrum colours as formed by mixing three primary colours (red, green, and violet) in varying proportions, three curves were drawn to the left of the spectrum line whose abscissae represented respectively the proportions of the three primary colours present in the corresponding spectrum colour. Horizontal distances from any point to these curves show the proportions in which the primary colours are to be mixed produce to the particular colour defined by that point. For points between the curves, the horizontal distances are not measured all in one direction, and therefore indicate abnormal or imaginary colours. The principle of the map was further illustrated by a sort of colour staff, consisting of three horizontal lines representing the three primary colour sensations (see figure) of such luminosities that equal lengths of



the three lines indicate white light. If points, R , G , V , be taken in these lines, then a cross line A will cut off lengths $A R$, $A G$, $A V$, whose mixture will produce a certain colour. If now A be moved parallel to itself towards the right, the colour will change by the addition of white light; moving A to the left means a subtraction of white light. When R , G , and V are properly chosen, a certain position, S , of the cross line, corresponds to a spectrum colour. The whole of the series of colours which can be obtained by adding white light to that spectrum colour can then be represented by sliding A towards the right. Positions S' and A' give colours complementary to S and A . The distinguishing features of such a series of colours are the differences $R - G$ and $G - V$, and the author calls the ratio $\frac{R-G}{G-V}$ the

"colour index." Passing up the spectrum from red to violet, NO. 1175, VOL. 46]

the index, which is first large and positive, diminishes and becomes negative between yellow and blue; it then passes through infinity, and becomes positive and decreases to zero. The subject of determining the indexes of colours resulting from the mixture in various proportions of two other colours whose indexes were known, was considered, and diagrams showing the various curves, exhibited. Experimental methods of determining the proportions of the primary colour sensations constituting the spectrum tints were described. A visitor inquired how the author's system provided for the class of colours outside the red and violet. He also desired a definition of "white light." He himself had never been able to produce pure white by mixture of colours, for a reddish violet generally resulted. On the other hand, he found it possible to match any other colour by mixture. Prof. Carey Foster thought Helmholtz was the first to propound the law which the author had attributed to Captain Abney. He wished to know how the amounts of colour sensation were supposed to be measured. White light he considered ought to be defined as light in which a normal eye, not fatigued, could perceive no preponderance of any colour. Mr. Blakesley said that if white light was a mixture, and only two unknowns were necessary, then any colour could be produced by the mixture of two other colours. Dr. Sumpner pointed out that white light was by no means a constant colour, but depended greatly on the source. He thought the author's map of a more absolute nature than that proposed by Maxwell. Dr. Hoffer inquired whether the intensities of each spectrum colour had been considered equal or otherwise taken into account, and also whether the results arrived at would be true for intensities other than those chosen. Mr. Baily, in reply, said Captain Abney had found the light from the crater in the positive carbon of an electric arc to be the most constant white, and in his method of experimenting errors due to variations of the source cancelled. The quantity of any spectrum colour was defined by the breadth of the band used, the breadth being small and measured on the scale of wave-lengths.—A paper on a mnemonic table for changing from electro-static to practical and C.G.S. electro-magnetic units was read by Mr. W. Gleed. In the table, which is given below, the abbreviations *Stat* and *Mag* are used to denote the electro-static and electro-magnetic units respectively, and v stands for 3×10^{10} :—

	Capacity.		Resistance.		Potential.		Current.		Quantity.	
	Units of		Units of		Units of		Units of		Units of	
Powers of 10 for practical and magnetic units
Small unit
Practical unit	...	Farad	...	Ohm	...	Volt	...	Ampere	...	Coulomb
Large unit	...	Mag	...	Stat	...	Stat	...	Mag	...	Mag
Factor for Stat and Mag

To form the table, the numbers 981 in the middle of the second line give the value of g . The end numbers are duplicated, giving 99,811. Below them in the fourth line come the names of the practical units, the initials forming the word *fovac*. Remembering that the electro-magnetic units of resistance and potential were too small for practical use, one places Mag above both Ohm and Volt. Ohm's law and definitions then show that the practical units of capacity, current, and quantity must be less than the electro-magnetic units, hence Mag must be written below Farad, Ampere, and Coulomb. Since the practical units are intermediate in magnitude between Stat and Mag, the vacant spaces are then filled in by Stat. The v 's in the bottom line are added from memory. Several examples showing the use of the table are worked out in the paper accompanying the table.—A paper on the law of colour in relation to chemical constitution, by William Akroyd, was read by Mr. Blakesley. The author has observed that, in cases of compounds having a constant radical, R , and a variable radical R' , the effect of an increase in the molecular weight of R is to make the colour of the compound tend towards the red end of the colour scale. Exceptions are, however, noted. Mr. H. M. Elder questioned the author's conclusions, saying that in many cases the colours tend towards blue.

Anthropological Institute, April 26.—Dr. Edward B. Tylor, F.R.S., President, in the chair.—Prof. R. K. Douglas read a paper on the social and religious ideas of the Chinese, as illustrated in the ideographic characters of the language. The paper begins with a short introduction, showing that the Chinese ideographic characters are picture-writings, and that as such they supply an interpretation of the meaning of words as these were understood by the inventors of the

characters representing them. Following on this is an account of the earliest or hieroglyphic form of the writing, with examples, and the development of this resulting in the ideographic characters. These are taken as being illustrative of the ideas of the people on political, social, scientific, and religious ideas. For example, the importance which was attached to the qualities of a sovereign is exemplified in the choice of the symbol employed to express a supreme ruler, the component parts of which together signify "ruler of himself." By means of the same graphic system a kingdom is shown as "men and arms within a frontier." Passing to the social habits of the people, their domestic life is illustrated by a number of ideograms descriptive of their household arrangements and relationships. In succession are traced in the written characters the ideas associated with men and women, their virtues and their failings; the notions associated with marriage; and the evidences of pastoral as well as of agricultural habits among the people. Turning to the popular religious faiths it is shown how prominent is the belief in the god of the soil, whose presence brings blessings, and whose averted countenance is followed by misfortune. The ideas associated with objects of nature are next treated of, and the paper concludes with references to the coinage of the country as described in the ideograms employed to represent its various forms.—Mr. Joseph Offord, Jun., read a paper on the mythology and psychology of the ancient Egyptians.

Entomological Society, April 27.—Mr. Robert McLachlan, F.R.S., Treasurer, in the chair.—Mr. C. G. Barrett exhibited, for Mr. Sabine, varieties of the following species: viz. one of *Papilio machaon*, bred by Mr. S. Baily, at Wicken, in 1886; one of *Argynnis lathonia*, taken at Dover in September 1883; one of *A. euphrosyne*, taken at Dover in 1890; and one of *A. selene*, taken at St. Oysth, in 1885, by Mr. W. H. Harwood. He also exhibited a long series of *Demas coryli*, reared by Major Still from larvæ fed exclusively on beech, which he said appeared to be the usual food of the species in Devonshire, instead of hazel or oak. Mr. Barrett also exhibited, for Mr. Sydney Webb, a number of varieties of *Arge galathea*, *Lasiommata megera*, *Hipparchia tithonus*, and *Ctenonympha pamphilus*, from the neighbourhood of Dover.—The Rev. J. Seymour St. John exhibited a variety of the female of *Hybernia progemma*, taken at Clapton in March last, in which the partially developed wings were equally divided in point of colour, the base being extremely dark and the outer portion of the wing very pale.—The Rev. Canon Fowler made some remarks on the subject of protective resemblance. His attention had been recently called to the fact that certain species of *Kallima* apparently lose their protective habit in some localities, and sit with their wings open; and Dr. A. R. Wallace had informed him that he had heard of a species sitting upside down on stalks, and thus, in another way, abandoning its protective habits. Mr. W. L. Distant referred to certain species of South African butterflies, which, when at rest, were protected by their resemblance to the plants on which they reposed, or by their resemblance to the rocks on which they settled, but which frequently abandoned their protective habit and sat with open wings. Mr. Barrett, Mr. McLachlan, Mr. Jacoby, Mr. Champion, Mr. H. Goss, Canon Fowler, and Mr. Frohawk continued the discussion.—Mr. Goss informed the meeting that, in pursuance of a resolution of the Council passed in March last, he and Mr. Elwes had represented the Society at the recent Government inquiry as to the safety and suitability of the proposed rifle range in the New Forest, held at Lyndhurst by the Hon. T. W. H. Pelham, on the 20th, 21st, 22nd, and 23rd inst., and that they had given evidence at such inquiry.

PARIS.

Academy of Sciences, April 25.—M. d'Abbadie in the chair.—On the photography of colours (second note), by M. G. Lippmann. In his first communication on colour photography, M. Lippmann remarked that the results would have been much better if isochromatic films had been employed. He has now obtained some new pictures, and presented them to the Academy. Silver bromide films, stained with azulin and cyanin, were used in connection with the arrangement previously explained. The solar spectrum appears to have been photographed in all its beauty with an exposure of about thirty seconds. On two of the plates the colours viewed by transmitted light are seen to be complementary to those given by reflected light. A photograph of a window containing red, green, blue, and yellow glasses appears to be very satisfactory. Others of a group of drapery and a parrot were obtained with an exposure of from five to ten

minutes. Several hours' exposure were given to a plate of oranges surmounted by a poppy, diffused light being employed. In all cases the forms of the objects were reproduced as well as the colours.—On the means employed in producing rain artificially, by M. Faye. The author states Espy's opinions on the formation of cyclones and other atmospheric disturbances, and quotes a letter on rain-making experiments carried out in Florida in 1857. He is of opinion that the theory which led to the experiments is wrong. For, according to M. Faye, (1) water-spouts, tornadoes, and cyclones move quickly during calm weather: ascending columns of heated air do not move. (2) Tornadoes and water-spouts whirl vigorously in a certain direction: ascending columns of air do not rotate, or only do so very faintly. (3) Tornadoes and water-spouts are cold in the centre: ascending columns of air are warm. (4) Tornadoes and water-spouts descend from clouds: ascending columns rise towards the clouds, &c.—On the division, according to terrestrial latitudes and longitudes, of the geological groups on the earth, by M. Alexis de Tillo. The following are the sums of the distribution of groups of rocks, &c., given in the tables for every ten degrees of latitude; the dimensions are expressed in millions of square kilometres:—

Pre-Cambrian	...	19'85	Glaciers	...	1'94
Primary	...	17'18	Igneous rocks	...	3'96
Secondary	...	10'85	Coral islands	...	0'02
Tertiary	...	8'71	Region { Explored	98'03	
Quaternary	...	19'17	{ Unexplored	36'16	
Gravels	...	7'35	Total	...	134'19

Tables are also given showing the proportion of the known surface of the globe occupied by each of the above groups, and also showing the distribution in longitude.—Observations of two new planets, discovered at Nice Observatory on March 22 and April 1, by M. Charlois. Observations for position are given.—Photography of the Ring Nebula in Lyra, by M. F. Denza.—Solar observations made during the first quarter of 1892, by M. Tacchini. (See Our Astronomical Column).—On a problem in mathematical analysis connected with equations in dynamics, by M. R. Liouville.—Direct and indirect measures of the angle which the surface of a liquid makes with glass: which it does not wet, by M. C. Maltézos.—On thermo-electric phenomena produced by the contact of two electrolytes, by M. Henri Bagard.—Addition to the law of the position of nervous centres, by M. Alexis Julien.—Analysis of a chromiferous clay from Brazil, by M. A. Terreil.—On the waters and muds of the lakes of Aiguebelette, Paladru, Nantua, and Sylans, by MM. L. Duparc and A. Delebecque.

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